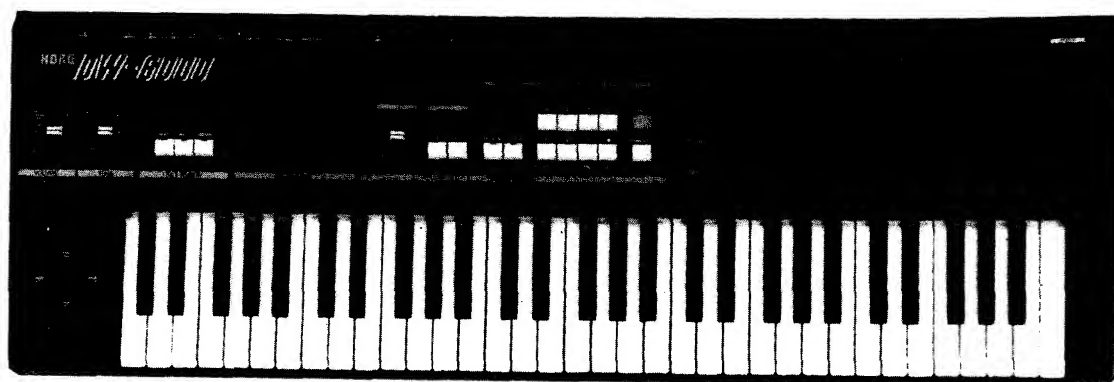


# KORG®



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## PROGRAMMABLE DIGITAL WAVEFORM SYNTHESIZER

# SERVICE MANUAL DW-6000

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**KEIO ELECTRONIC LABORATORY CORPORATION**  
**TOKYO/JAPAN**

# 1. SPECIFICATIONS

• Keyboard	61 keys (C ~ C)	• Display	Program Number, Parameter Number, Parameter Value, Bank hold indicator
• Voice	6 Voice	• Tape interface	Save, Load, Verify, Cancel
• OSC 1*	Octave (16', 8', 4'), Waveform (1 ~ 8), Level adjustment	• Input jacks	FROM TAPE (HIGH/LOW), DAMPER ( $\perp$ GND), PORTAMENTO ( $\perp$ GND) Program up ( $\perp$ GND)
• OSC 2*	Octave (16', 8', 4'), Waveform (1 ~ 8), Interval (Unison, Minor 3rd, Major 3rd, Perfect 4th, Perfect 5th), Detune (24 cents MAX), Level adjustment	• Output jacks	Output (R, L/MONO, HIGH/LOW), PHONES, TO TAPE
• Noise*	Level adjustment (White noise)	• Tape switch	ENABLE/DISABLE
• VCF*	Cutoff Frequency, Resonance Keyboard Track (OFF, HALF, FULL), EG Polarity ( $\wedge$ , $\vee$ ), EG Intensity	• Write switch	ENABLE/DISABLE
• Chorus*	ON/OFF	• MIDI jacks	IN, OUT, THRU
• VCF EG*	Attack time, Decay time, Break Point level, Slope time, Sustain level, Release time	• Power supply	Local voltage
• VCA EG*	Attack time, Decay time, Break Point level, Slope time, Sustain level, Release time	• Power consumption	34 W
• MG*	Frequency, Delay time, OSC intensity VCF intensity	• Weight	9.3 kg
• Bend*	Maximum OSC Bend ( $\pm 1$ Octave MAX), VCF Bend ON/OFF	• Dimensions	998 (W) $\times$ 338 (D) $\times$ 101 (H) mm
• Portamento*	Portamento time	• Accessories	AC power cord, Connection cord, Data Cassette
• MIDI	Receive Channel (ch 1 ~ 16), ENABLE (NOTE DATA/ALL), OMNI (ON/OFF)		(*Programmable)
• Volume	Adjustable		
• TUNE	$\pm 50$ cents		
• Joystick	X axis (OSC Bend, VCF Bend) +Y axis (OSC modulation) -Y axis (VCF modulation)		
• Key assign mode	POLY 1, POLY 2, UNISON		
• Programmer	Value (edit slider, UP/DOWN switches), PROGRAM/PARAMETER switches, Number select buttons (1 ~ 8), WRITE switch, BANK HOLD switch		

## 2. MIDI IMPLEMENTATION

### 1. TRANSMITTED DATA

#### 1. CHANNEL MESSAGE

STATUS	SECOND	THIRD	DESCRIPTION
1 0 0 0    0 0 0 0	0 k k k    k k k k	0 1 0 0    0 0 0 0	NOTE OFF (NOTE 1)
1 0 0 1    0 0 0 0	0 k k k    k k k k	0 1 0 0    0 0 0 0	NOTE ON (NOTE 1)
1 0 1 1    0 0 0 0	0 0 0 0    0 0 0 1	0 v v v    v v 0 0	OSC MODULATION (NOTE 2)
	0 0 0 0    0 0 1 0	0 v v v    v v 0 0	VCF MODULATION (NOTE 3)
	0 1 0 0    0 0 0 0	0 0 0 0    0 0 0 0	DAMPER PEDAL OFF
	0 1 0 0    0 0 0 0	0 1 1 1    1 1 1 1	DAMPER PEDAL ON
	0 1 0 0    0 0 0 1	0 0 0 0    0 0 0 0	PORTAMENTO OFF
	0 1 0 0    0 0 0 1	0 1 1 1    1 1 1 1	PORTAMENTO ON
1 1 0 0    0 0 0 0	0 p p p    p p p p		PROGRAM CHANGE pppppp=0 – 63 (NOTE 4)
1 1 1 0    0 0 0 0	0 0 0 0    0 0 0 0	0 b b b    b b b b	PITCH BEND LSB 0 – 0 – 0 MSB 0 – 40H – 7FH (NOTE 5)

NOTE : 1. NOTE NUMBER (0kkkkkkk) = 36 – 96.

2. PITCH MODULATION range has 5 bits resolution (0vvvvv00)

3. VCF MODULATION range has 5 bits resolution (0vvvvv00)

4. PROGRAM NUMBER (0ppppppp) correspond to DISPLAY NUMBER on the PANEL which will be the following:

DISPLAY NUMBER	PROGRAM NUMBER
#11	0
#12	1
.	.
#87	62
#88	63

5. PITCH BENDER range has 7 bits resolution (0bbbbbbb) only by MSB.

### 2. SYSTEM EXCLUSIVE MESSAGE

#### (a) DEVICE ID

BYTE	DESCRIPTION
1 1 1 1    0 0 0 0	EXCLUSIVE
0 1 0 0    0 0 1 0	KORG ID 42H
0 0 1 1    0 0 0 0	FORMAT ID 30H
0 0 0 0    0 1 0 0	DW-6000 ID 04H
1 1 1 1    0 1 1 1	EOX

NOTE: 6. If receive DEVICE ID REQUEST, DEVICE ID message will be sent.

#### (b) WRITE COMPLETED

BYTE	DESCRIPTION
1 1 1 1    0 0 0 0	EXCLUSIVE
0 1 0 0    0 0 1 0	KORG ID 42H
0 0 1 1    0 0 0 0	FORMAT ID 30H
0 0 0 0    0 1 0 0	DW-6000 ID 04H
0 0 1 0    0 0 0 1	WRITE COMPLETED 21H
1 1 1 1    0 1 1 1	EOX

NOTE : 7. If receive WRITE REQUEST and program write complete, WRITE COMPLETED message will be sent.

## (c) WRITE ERROR

BYTE	DESCRIPTION
1 1 1 1 0 0 0 0	EXCLUSIVE
0 1 0 0 0 0 1 0	KORG ID 42H
0 0 1 1 0 0 0 0	FORMAT ID 30H
0 0 0 0 0 1 0 0	DW-6000 ID 04H
0 0 1 0 0 0 1 0	WRITE ERROR 22H
1 1 1 1 0 1 1 1	EOX

**NOTE : 8.** If receive WRITE REQUEST and program write incomplete (when WRITE DISABLE is chosen on the rear panel), WRITE ERROR will be sent.

## (d) DATE SAVE (DATA DUMP)

BYTE	DESCRIPTION
1 1 1 1 0 0 0 0	EXCLUSIVE
0 1 0 0 0 0 1 0	KORG ID 42H
0 0 1 1 0 0 0 0	FORMAT ID 30H
0 0 0 0 0 1 0 0	DW-6000 ID 04H
0 1 0 0 0 0 0 0	DATA DUMP 40H
0 v v v v v v v	DATA 26bytes (SEE DW-6000 BIT MAP)
⋮	
0 v v v v v v v	
1 1 1 1 0 1 1 1	EOX

**NOTE : 9.** If receive DATA SAVE REQUEST, DATA SAVE (DATA DUMP) will be sent.

## 2. RECOGNIZED RECEIVE DATA

## 1. CHANNEL MESSAGE

STATUS	SECOND	THIRD	DESCRIPTION
1 0 0 0 n n n n	0 k k k k k k k k	0 x x x x x x x	NOTE OFF (NOTE 11) velocity will be ignored. NOTE ON (0vvvvvv>0) (NOTE 11) velocity will be ignored. NOTE OFF (NOTE 11)
1 0 0 1 n n n n	0 k k k k k k k k	0 v v v v v v v v	
	0 k k k k k k k k	0 0 0 0 0 0 0 0	
1 0 1 1 n n n n	0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 1 1 1 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 1 0 0 0 0 0 1	0 v v v v v v x x 0 v v v v v v x x 0 v v v v v v v v 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1	OSC MODULATION (NOTE 12) VCF MODULATION (NOTE 13) VOLUME (NOTE 14) DAMPER PEDAL OFF DAMPER PEDAL ON PORTAMENTO OFF PORTAMENTO ON
1 0 1 1 n n n n	0 1 1 1 1 0 1 1 0 1 1 1 1 1 0 0 0 1 1 1 1 1 0 1 0 1 1 1 1 1 1 0 0 1 1 1 1 1 1 1	0 x x x x x x x 0 0 0 0 0 0 0 0	ALL NOTES OFF OMNI OFF (ALL NOTES OFF) OMNI ON (ALL NOTES OFF) (ALL NOTES OFF) (ALL NOTES OFF)
1 1 0 0 n n n n	0 p p p p p p p p		PROGRAM CHANGE (NOTE 15)
1 1 1 0 n n n n	0 x x x x x x x x	0 b b b b b b b b	PITCH BEND LSB will be ignored. MSB will be recognized. (NOTE 16)

**NOTE : 10.** nnnn:0-15. When the mode is OMNI ON, all the data will be received. When the mode is OMNI OFF, only data of the channel designated by Parameter #81 will be received. As to MODE MESSAGE, however, designated channel data only will be received even if the mode is OMNI ON.

11. NOTE NUMBER (0kkkkkkk) = 24 – 108. If the data except above range were received, the data will be transposed to the same note on the nearest octave.
12. PITCH MODULATION range has 5 bits resolution (0vvvvvxx) bit 0 - bit 1 will be ignored.
13. VCF MODULATION range has 5 bits resolution (0vvvvvxx) bit 0 - bit 1 will be ignored.
14. VOLUME range has 7 bits resolution (0vvvvvvv).
15. PROGRAM NUMBER (0ppppppp) = 0 - 63. If the data is larger than 63, it will be recognized as a number which is taken 64 from it.
16. PITCH BENDER range has 7 bits resolution (0bbbbbbb) only by MSB.

## 2. SYSTEM EXCLUSIVE MESSAGE

### (a) DEVICE ID REQUEST

BYTE	DESCRIPTION
1 1 1 1 0 0 0 0	EXCLUSIVE
0 1 0 0 0 0 1 0	KORG ID 42H
0 1 0 0 0 0 0 0	FORMAT ID 40H
1 1 1 1 0 1 1 1	EOX

### (b) WRITE REQUEST

BYTE	DESCRIPTION
1 1 1 1 0 0 0 0	EXCLUSIVE
0 1 0 0 0 0 1 0	KORG ID 42H
0 0 1 1 0 0 0 0	FORMAT ID 30H
0 0 0 0 0 1 0 0	DW-6000 ID 04H
0 0 0 1 0 0 0 1	WRITE REQUEST 11H
0 p p p p p p p p	PROGRAM NUMBER ppppppp = 0 – 63
1 1 1 1 0 1 1 1	EOX

### (c) DATA SAVE REQUEST

BYTE	DESCRIPTION
1 1 1 1 0 0 0 0	EXCLUSIVE
0 1 0 0 0 0 1 0	KORG ID 42H
0 0 1 1 0 0 0 0	FORMAT ID 30H
0 0 0 0 0 1 0 0	DW-6000 ID 04H
0 0 0 1 0 0 0 0	DATA SAVE REQUEST 10H
1 1 1 1 0 1 1 1	EOX

### (d) DATA LOAD (DATA DUMP)

BYTE	DESCRIPTION
1 1 1 1 0 0 0 0	EXCLUSIVE
0 1 0 0 0 0 1 0	KORG ID 42H
0 0 1 1 0 0 0 0	FORMAT ID 30H
0 0 0 0 0 1 0 0	DW-6000 ID 04H
0 1 0 0 0 0 0 0	DATA DUMP 40H
0 v v v v v v v v	DATA 26bytes (See DW-6000 BIT MAP)
⋮	
0 v v v v v v v v	
1 1 1 1 0 1 1 1	EOX

### (e) PARAMETER CHANGE

BYTE	DESCRIPTION
1 1 1 1 0 0 0 0	EXCLUSIVE
0 1 0 0 0 0 1 0	KORG ID 42H
0 0 1 1 0 0 0 0	FORMAT ID 30H
0 0 0 0 0 1 0 0	DW-6000 ID 04H
0 1 0 0 0 0 0 1	PARAMETER CHANGE 41H
0 v v v v v v v v	PARAMETER OFFSET (See DW-6000 BIT MAP)
0 v v v v v v v v	PARAMETER VALUE (See DW-6000 BIT MAP)
1 1 1 1 0 1 1 1	EOX



### 3. DATA DUMP REFERENCE

#### 1. DW-6000 BIT MAP

PARAMETER  OFFSET	PARAMETER VALUE							
	MSB b <sub>7</sub>	b <sub>6</sub>	b <sub>5</sub>	b <sub>4</sub>	b <sub>3</sub>	b <sub>2</sub>	b <sub>1</sub>	LSB b <sub>0</sub>
0	0	0	ASSIGN MODE		BEND OSC			
1	0	0	0	PORTAMENTO TIME				
2	0	0	0	OSC1 LEVEL				
3	0	0	0	OSC2 LEVEL				
4	0	0	0	NOISE LEVEL				
5	0	0	CUTOFF					
6	0	0	0	RESONANCE				
7	0	0	0	VCF EG INT				
8	0	0	0	VCF EG ATTACK				
9	0	0	0	VCF EG DECAY				
10	0	0	0	VCF EG BREAK P.				
11	0	0	0	VCF EG SLOPE				
12	0	0	0	VCF EG SUSTAIN				
13	0	0	0	VCF EG RELEASE				
14	0	0	0	VCA EG ATTACK				
15	0	0	0	VCA EG DECAY				
16	0	0	0	VCA EG BREAK P.				
17	0	0	0	VCA EG SLOPE				
18	0	0	BEND VCF	VCA EG SUSTAIN				
19	0	OSC1 OCT		VCA EG RELEASE				
20	0	OSC2 OCT		MG FREQ				
21	0	KBD TRACK		MG DELAY				
22	0	0	POLARITY	MG OSC				
23	0	0	CHORUS	MG VCF				
24	0	0	OSC1 WF			OSC2 WF		
25	0	0	OSC2 INTERVAL			OSC2 DETUNE		

## 2. DW-6000 BIT MAP AND CORRESPONDING PARAMETER VALUES

PARAMETER NAME	PARAMETER OFFSET	BIT	CORRESPONDING PANEL DISPLAY
ASSIGN MODE	0	b <sub>5</sub> - b <sub>4</sub>	00=POLY1 01=POLY2 10=UNISON 11=INHIBIT

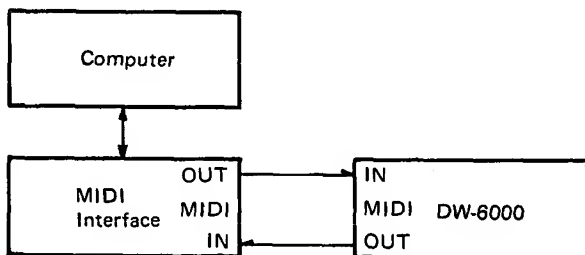
PARAMETER NAME	PARAMETER OFFSET	BIT	CORRESPONDING PANEL VALUE	PARAMETER NUMBER
BEND OSC	0	b <sub>3</sub> - b <sub>0</sub>	0000 ~ 1100=0 ~ 12 1101 ~ 1111=INHIBIT	71
PORTAMENTO TIME	1	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	73
OSC1 LEVEL	2	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	13
OSC2 LEVEL	3	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	23
NOISE LEVEL	4	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	26
CUTOFF	5	b <sub>5</sub> - b <sub>0</sub>	000000 ~ 111111=0 ~ 63	31
RESONANCE	6	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	32
VCF EG INT	7	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	35
VCF EG ATTACK	8	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	41
VCF EG DECAY	9	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	42
VCF EG BREAK P.	10	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	43
VCF EG SLOPE	11	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	44
VCF EG SUSTAIN	12	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	45
VCF EG RELEASE	13	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	46
VCA EG ATTACK	14	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	51
VCA EG DECAY	15	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	52
VCA EG BREAK P.	16	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	53
VCA EG SLOPE	17	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	54
BEND VCF	18	b <sub>5</sub>	0=0(OFF) 1=1(ON)	72
VCA EG SUSTAIN	18	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	55
OSC1 OCT	19	b <sub>6</sub> - b <sub>5</sub>	00=16 01=8 10=4 11=INHIBIT	11
VCA EG RELEASE	19	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	56
OSC2 OCT	20	b <sub>6</sub> - b <sub>5</sub>	00=16 01=8 10=4 11=INHIBIT	21
MG FREQ	20	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	61
KBD TRACK	21	b <sub>6</sub> - b <sub>5</sub>	00=0(OFF) 01=1(HALF) 10=2(FULL) 11=INHIBIT	33
MG DELAY	21	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	62
EG POLARITY	22	b <sub>5</sub>	0=1(  ) 1=2(  )	34
MG OSC	22	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	63
CHORUS	23	b <sub>5</sub>	0=0(OFF) 1=1(ON)	36
MG VCF	23	b <sub>4</sub> - b <sub>0</sub>	00000 ~ 11111=0 ~ 31	64
OSC1 WF	24	b <sub>5</sub> - b <sub>3</sub>	000 ~ 111=1 ~ 8	12
OSC2 WF	24	b <sub>2</sub> - b <sub>0</sub>	000 ~ 111=1 ~ 8	22
OSC2 INTERVAL	25	b <sub>5</sub> - b <sub>3</sub>	000=1 001=-3 010=3 011=4 100=5 101 ~ 111=INHIBIT	24
OSC2 DETUNE	25	b <sub>2</sub> - b <sub>0</sub>	000 ~ 110=0 ~ 6 111=	25

### 3. INTERFACE WITH PERSONAL COMPUTER

When using a computer for DW-6000 control and communications, a system exclusive message and the following data types are employed.

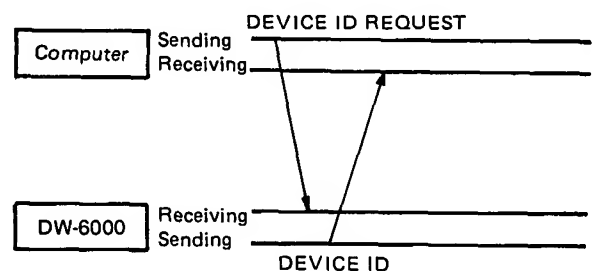
Sending	Receiving
<b>DEVICE ID</b> : Identifies the equipment. Sent upon receiving a <b>DEVICE ID REQUEST</b> .	<b>DEVICE ID REQUEST</b> : A request for the equipment's MIDI identification number.
<b>WRITE COMPLETED</b> : Sent in response to a <b>WRITE REQUEST</b> , this indicates that the <b>PROGRAM WRITE</b> task has been successfully completed.	<b>WRITE REQUEST</b> : A request for the DW-6000 to write data for the present sound to program memory.
<b>WRITE ERROR</b> : Sent in response to a <b>WRITE REQUEST</b> , this means that the synth is set to the <b>WRITE DISABLE</b> mode so <b>PROGRAM WRITE</b> task cannot be completed.	<b>DATA SAVE REQUEST</b> : A request for the DW-6000 to send data for the present sound.
<b>DATA SAVE (DATA DUMP)</b> : In response to a <b>DATA SAVE REQUEST</b> , this sends the data for the sound presently being produced.	<b>PARAMETER CHANGE</b> : Used to change parameters of the current sound.

The above examples require that the DW-6000 and computer interface be connected via their respective MIDI IN and MIDI OUT Jacks as shown here.

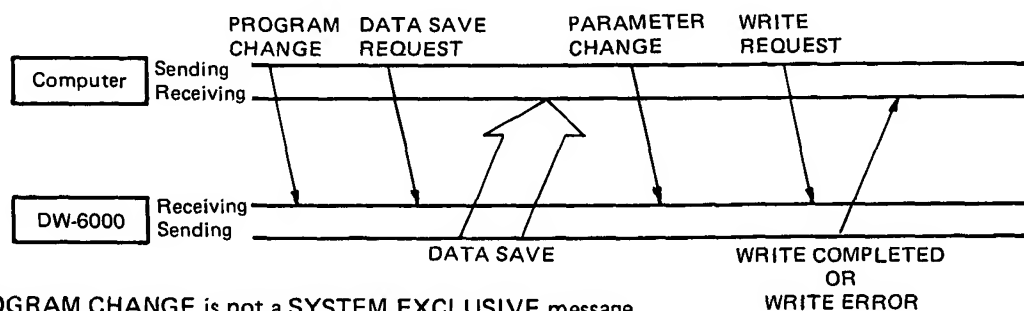


The above data types are used for communication in the following ways.

- (1) To find the ID number for equipment connected to the computer.

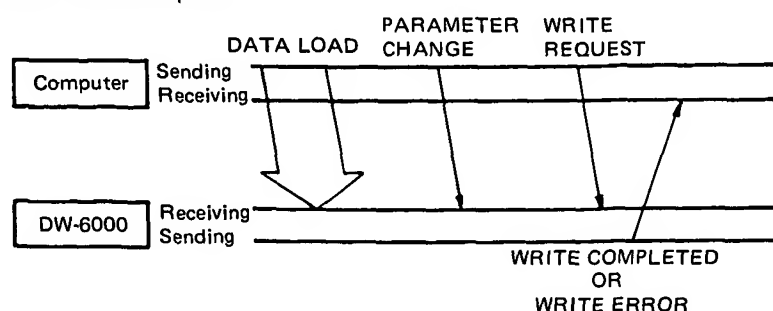


- (2) To edit sound data within the DW-6000.



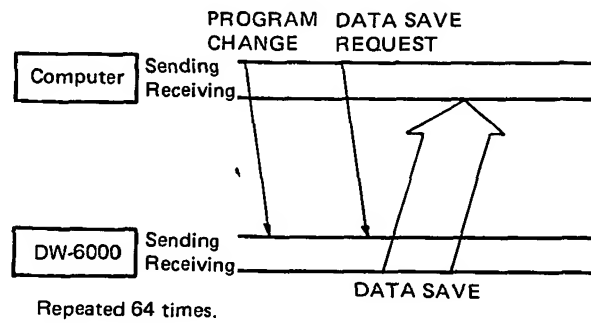
**Note:** PROGRAM CHANGE is not a SYSTEM EXCLUSIVE message.

- (3) To edit data already available in the computer.

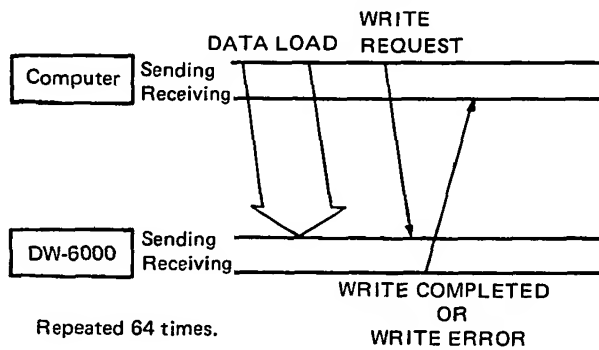




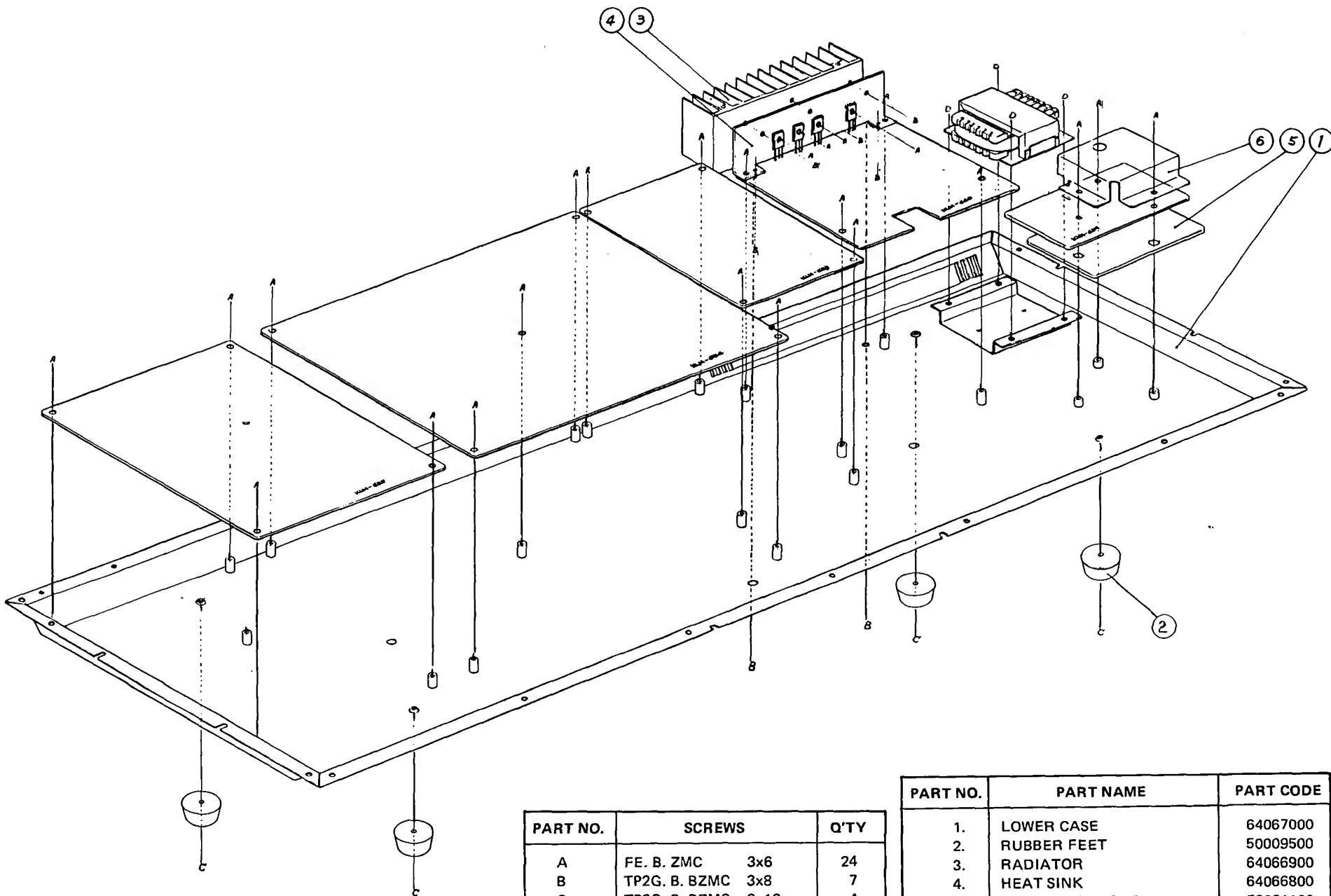
- (4) To load all 64 sound programs from the computer to the DW-6000.



- (5) To save all 64 sound programs from the DW-6000 to the computer.

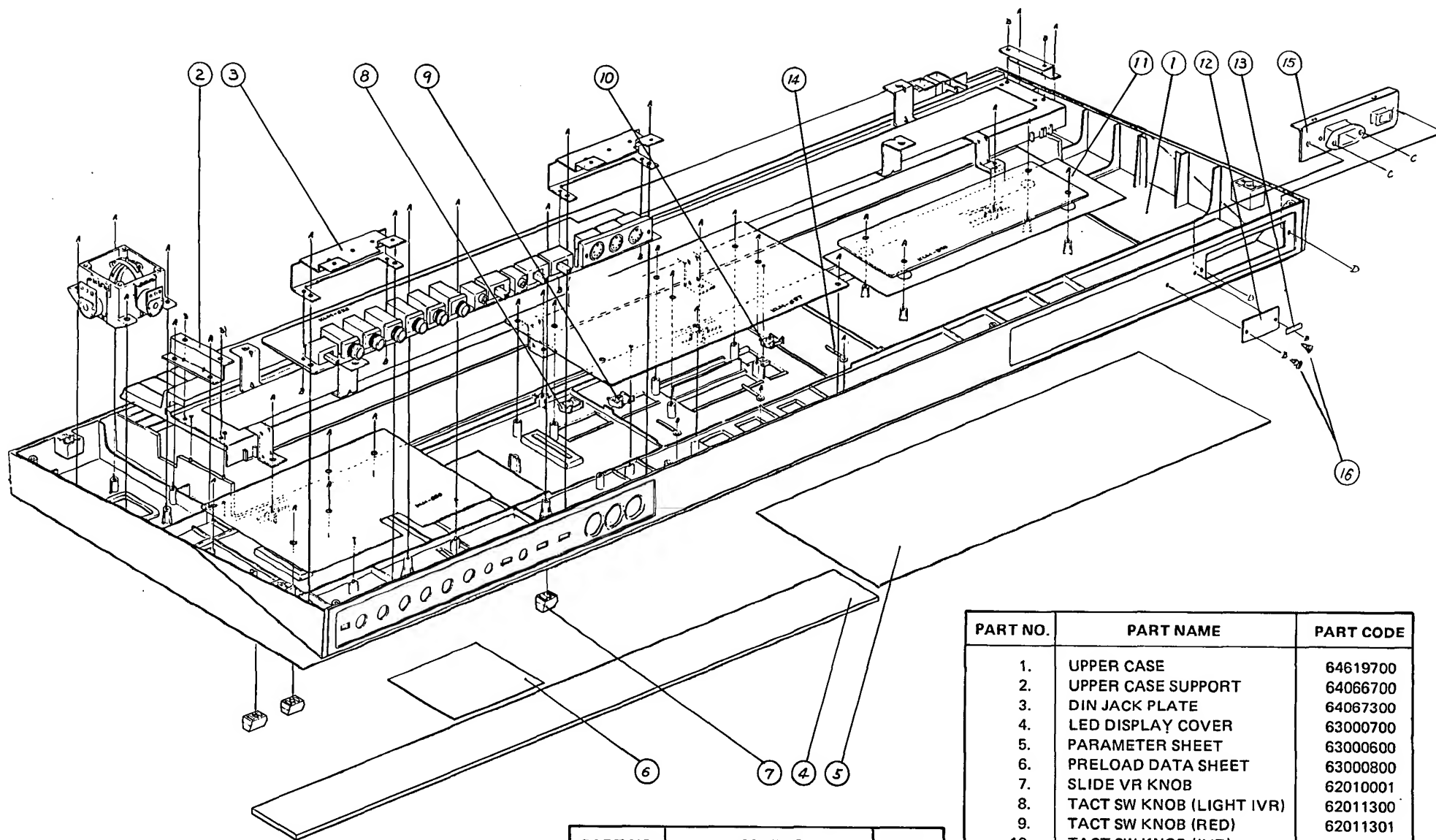


#### 4. STRUCTURAL DIAGRAM



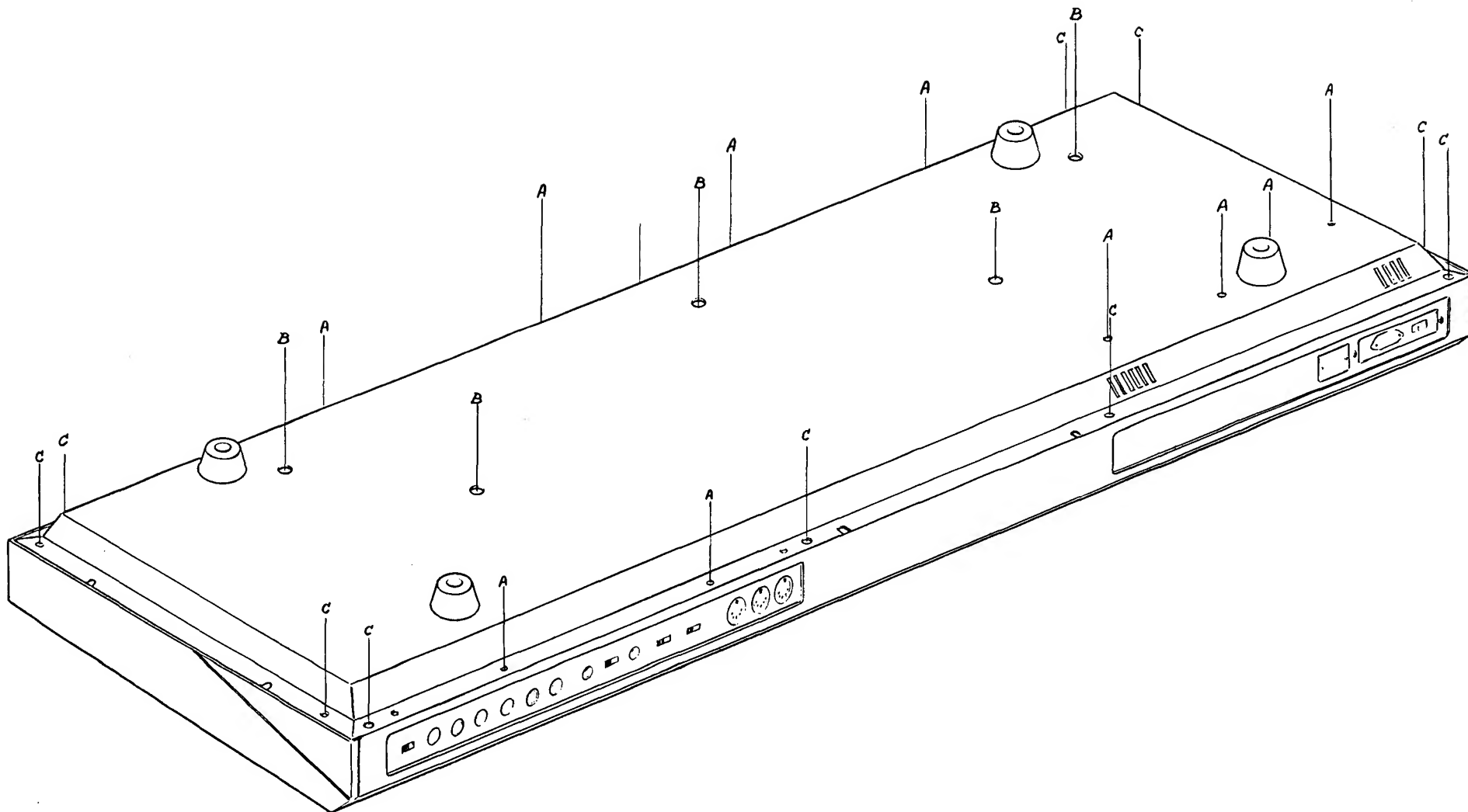
PART NO.	SCREWS		Q'TY
A	FE. B. ZMC	3x6	24
B	TP2G. B. BZMC	3x8	7
C	TP2G. B. BZMC	3x12	4
D	FE. B. ZMC	4x8	4

PART NO.	PART NAME	PART CODE
1.	LOWER CASE	64067000
2.	RUBBER FEET	50009500
3.	RADIATOR	64066900
4.	HEAT SINK	64066800
5.	SHIELDING SHEET	58021100
6.	SHIELDING COVER	—



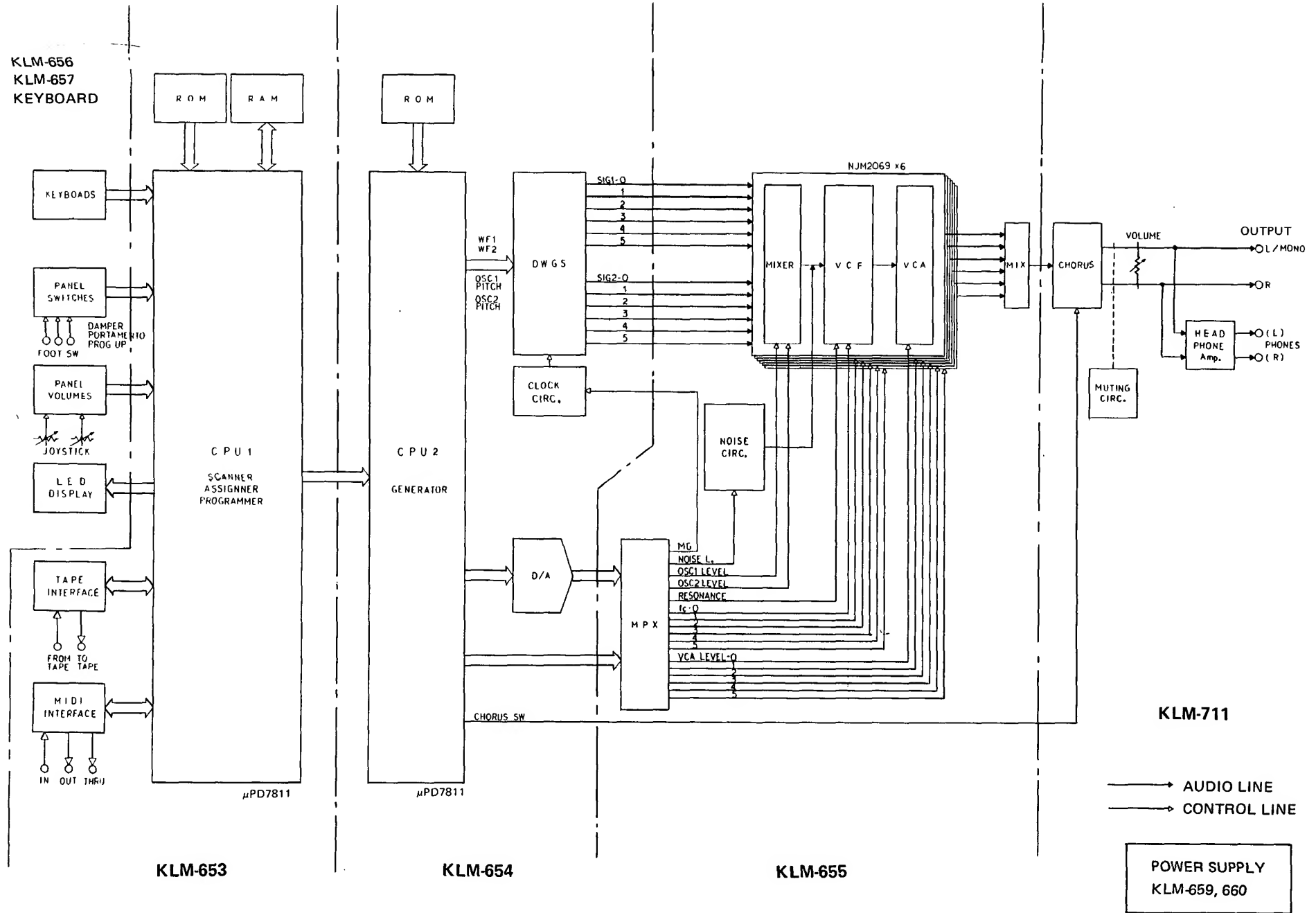
PART NO.	SCREWS	Q'TY
A	PLAX. B. ZMC 3x8	40
B	TP2G. B. BZMC 3x8	6
C	FE. F. BZMC 3x8	2
D	FE. B. BZMC 3x8	2

PART NO.	PART NAME	PART CODE
1.	UPPER CASE	64619700
2.	UPPER CASE SUPPORT	64066700
3.	DIN JACK PLATE	64067300
4.	LED DISPLAY COVER	63000700
5.	PARAMETER SHEET	63000600
6.	PRELOAD DATA SHEET	63000800
7.	SLIDE VR KNOB	62010001
8.	TACT SW KNOB (LIGHT IVR)	62011300
9.	TACT SW KNOB (RED)	62011301
10.	TACT SW KNOB (IVR)	62011400
11.	SHIELDING SHEET	63000900
12.	NAME PLATE	
13.	SERIAL NUMBER SEAL	
14.	SPIRAL CLIP	54008600
15.	METAL FITTING OF SW	64067100



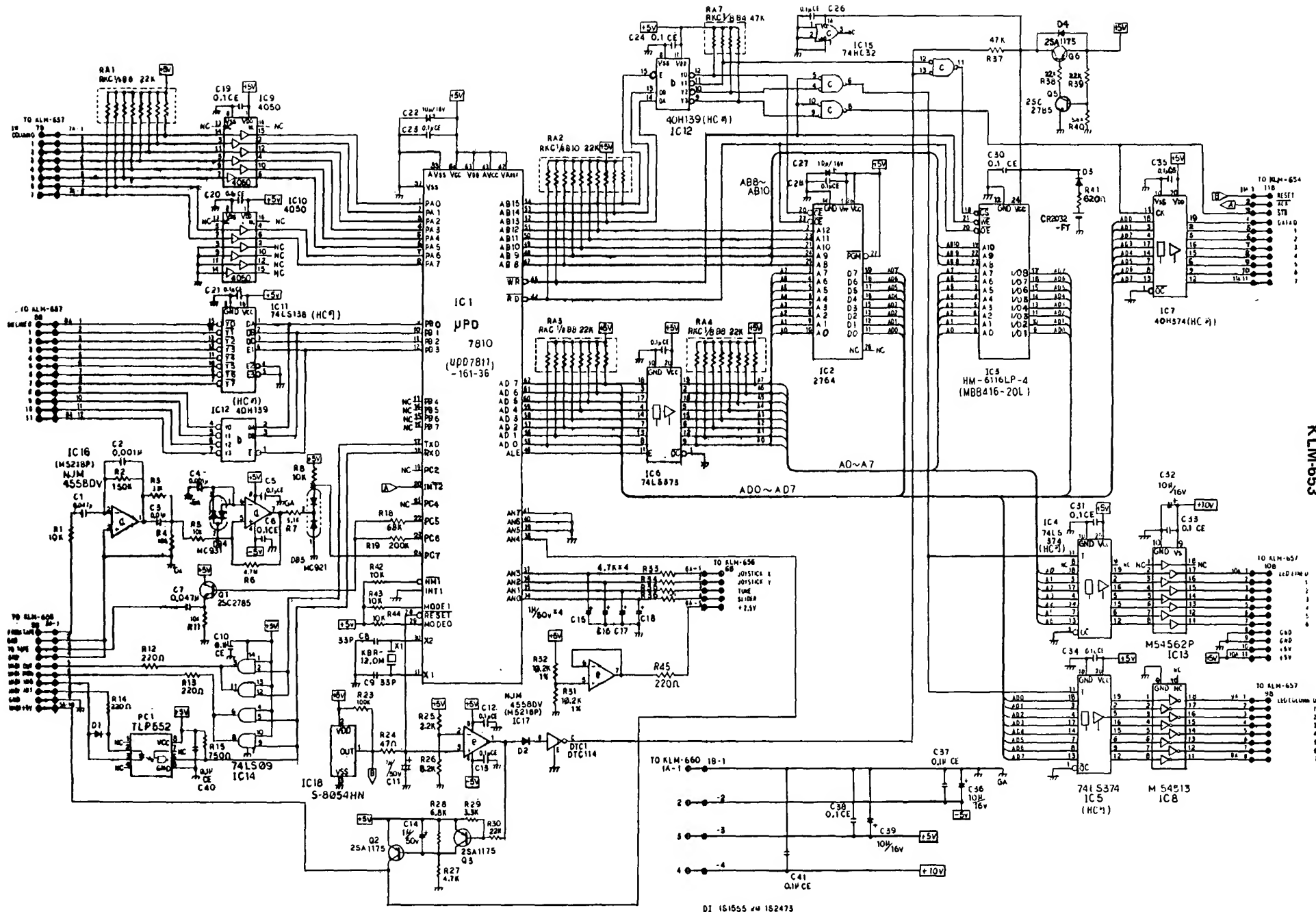
PART NO.	SCREWS	Q'TY
A	TP2G. B. BZMC 3x8	10
B	FE. B. BZMC 5x8	5
C	PLAX. B. BZMC 4x10	10

# 5. BLOCK DIAGRAM

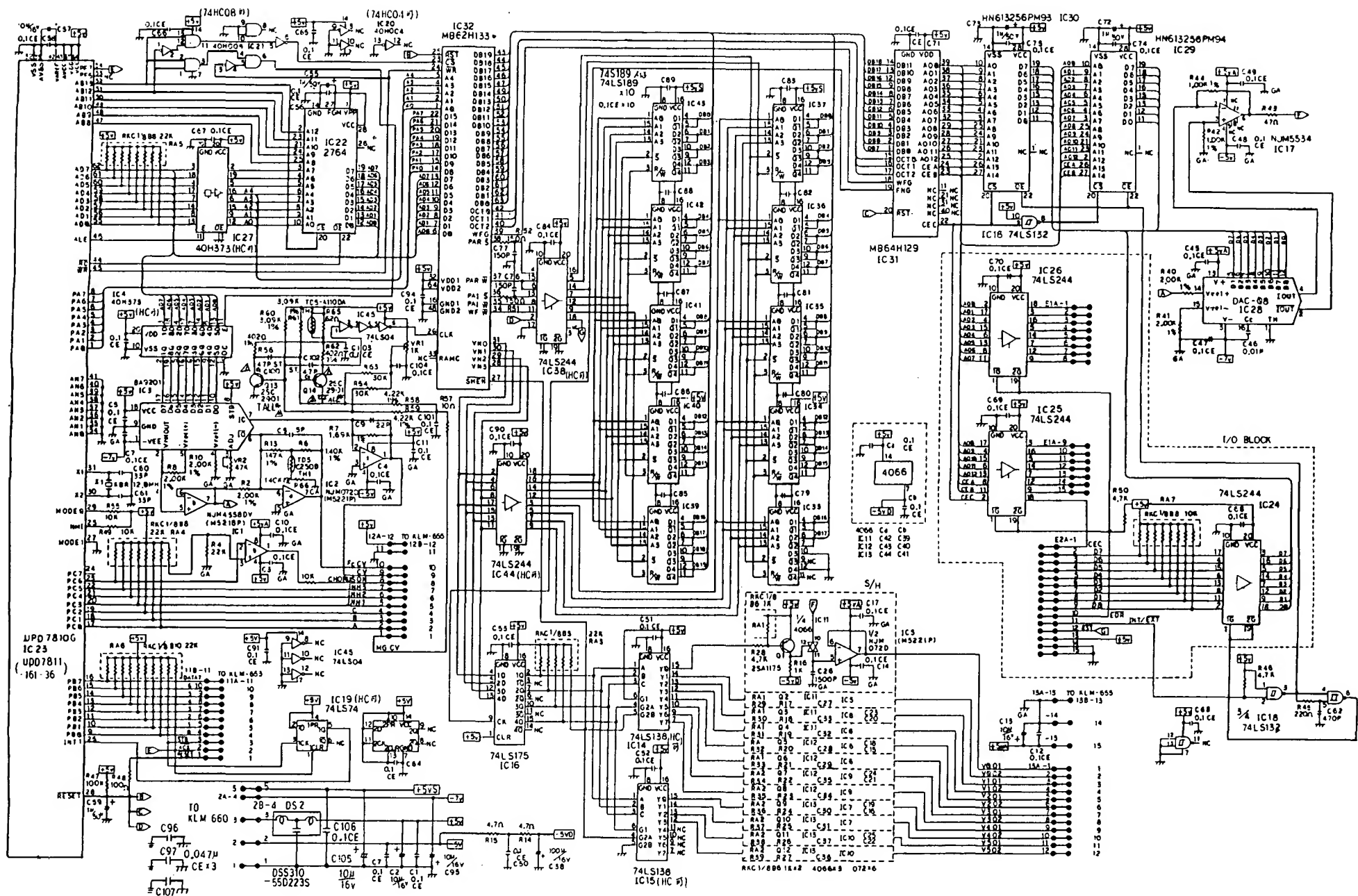


# 6. CIRCUIT DIAGRAM

KLM-653

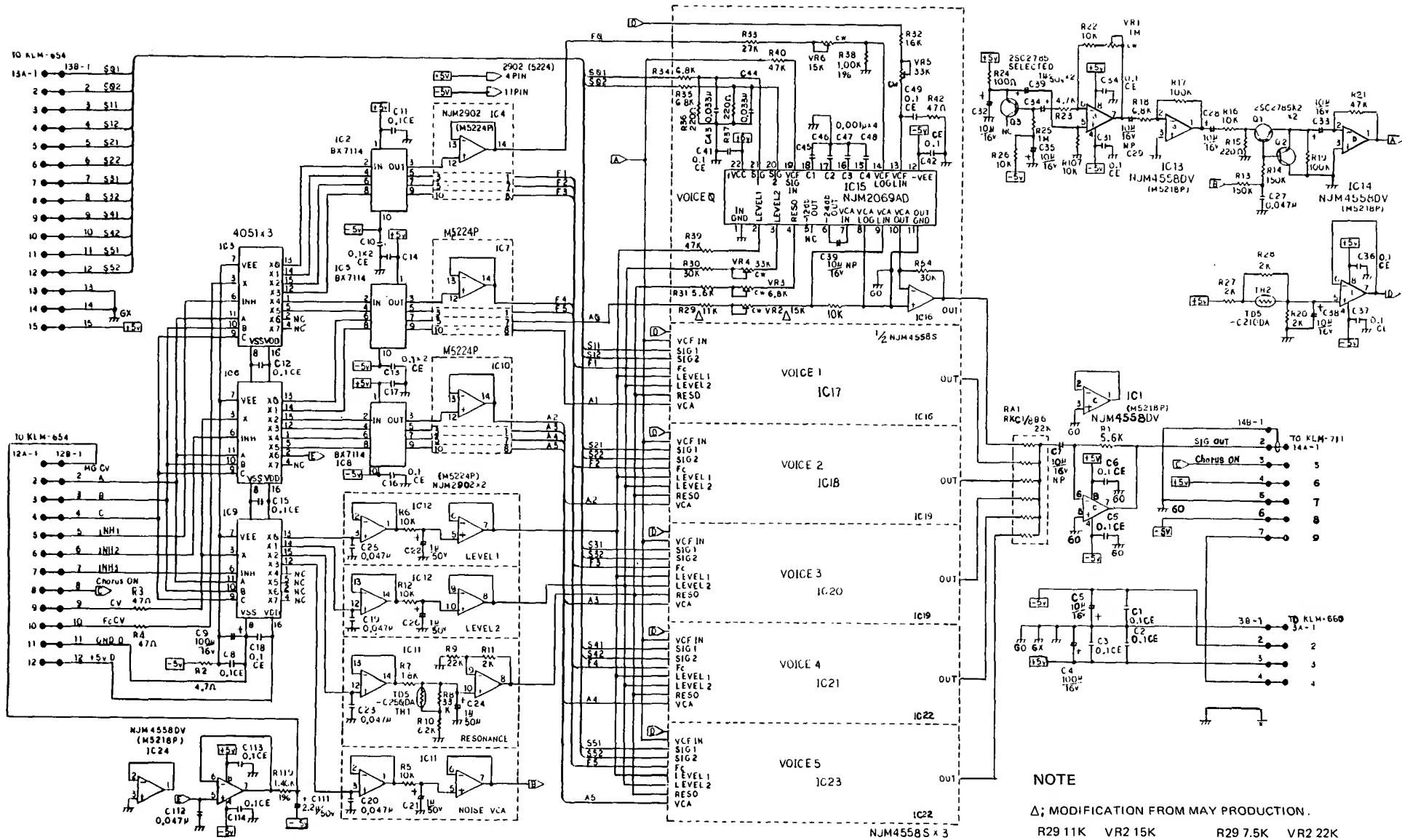


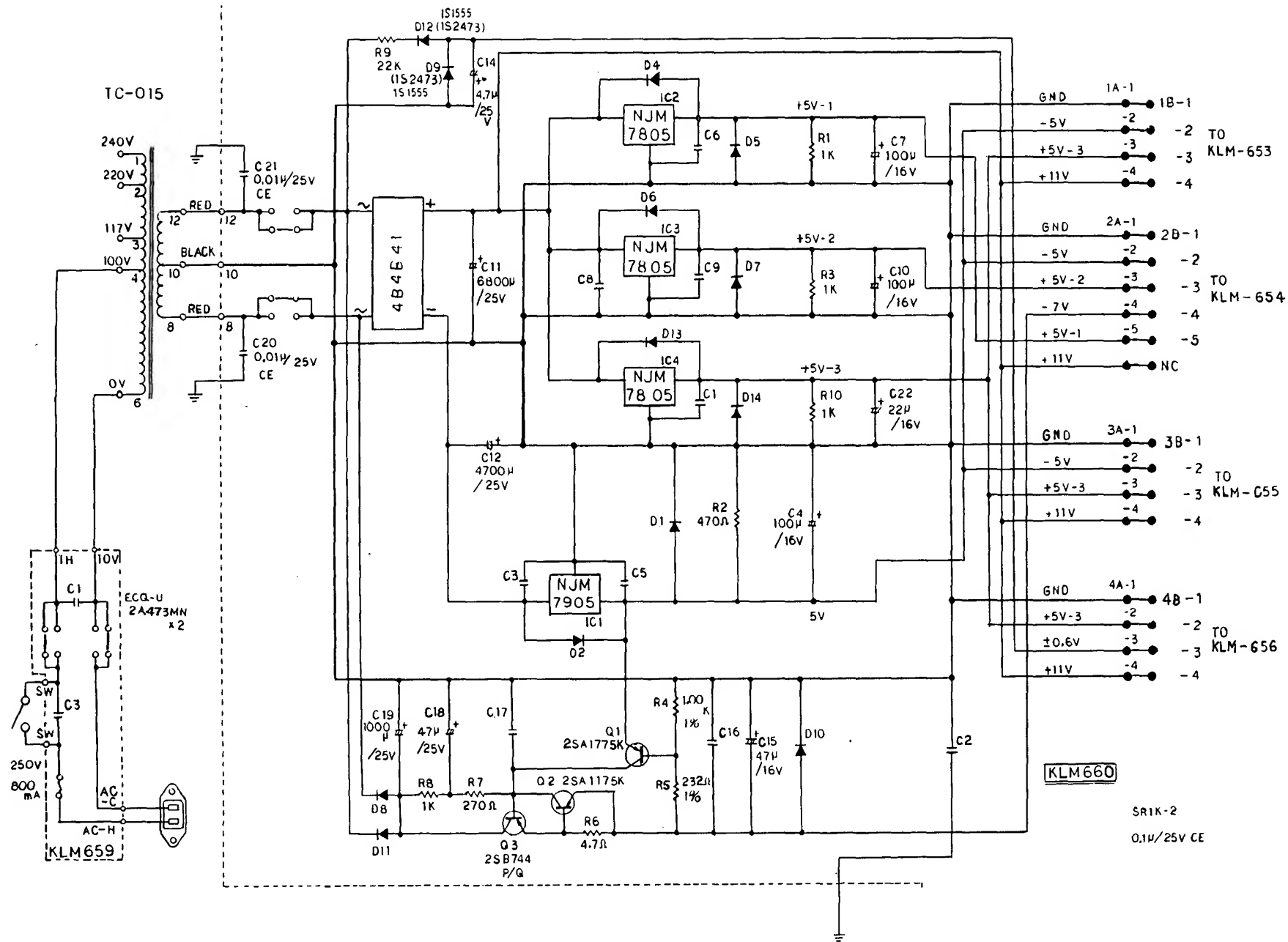




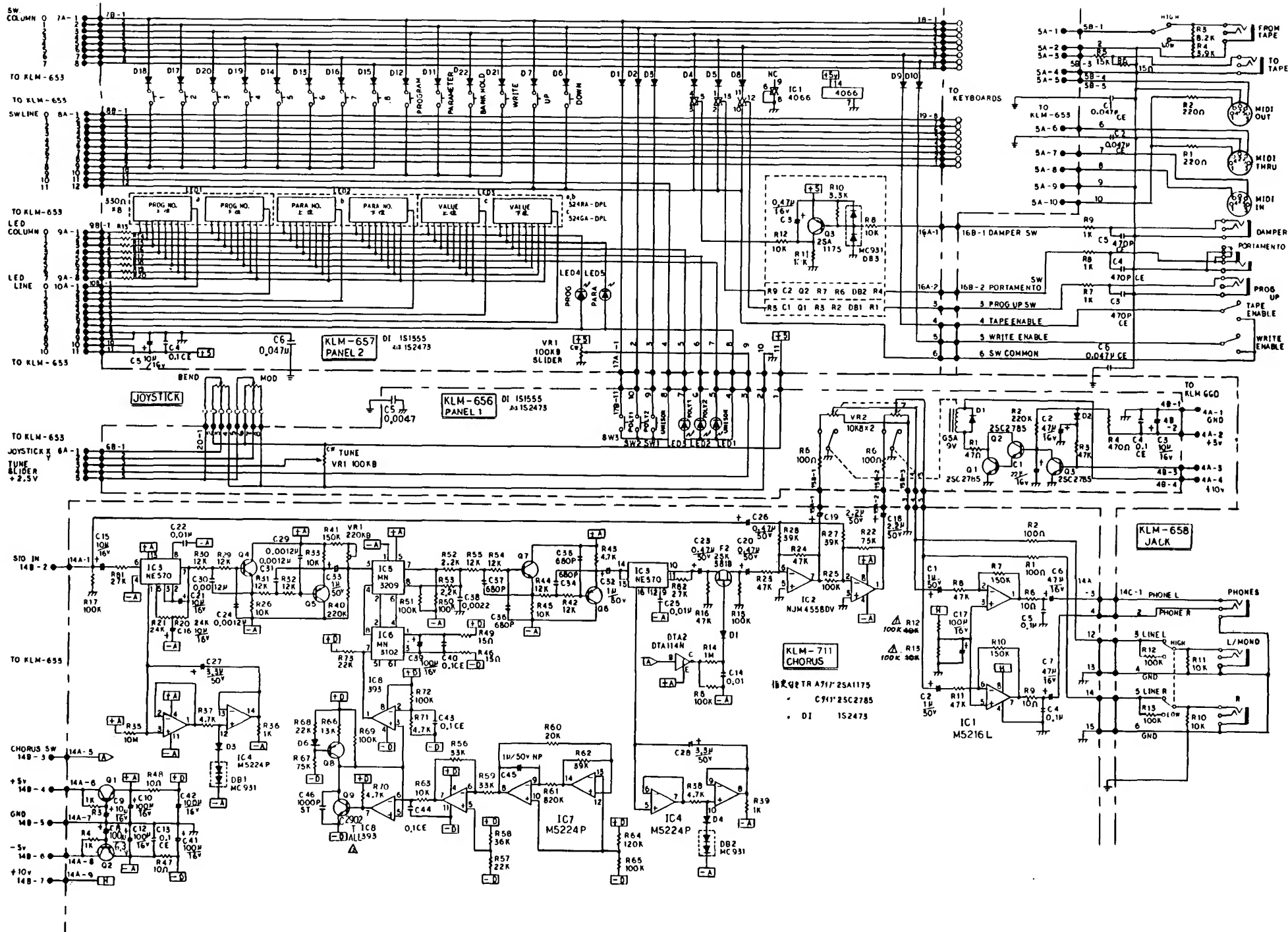
KLM-655 (NEW PRODUCTION)







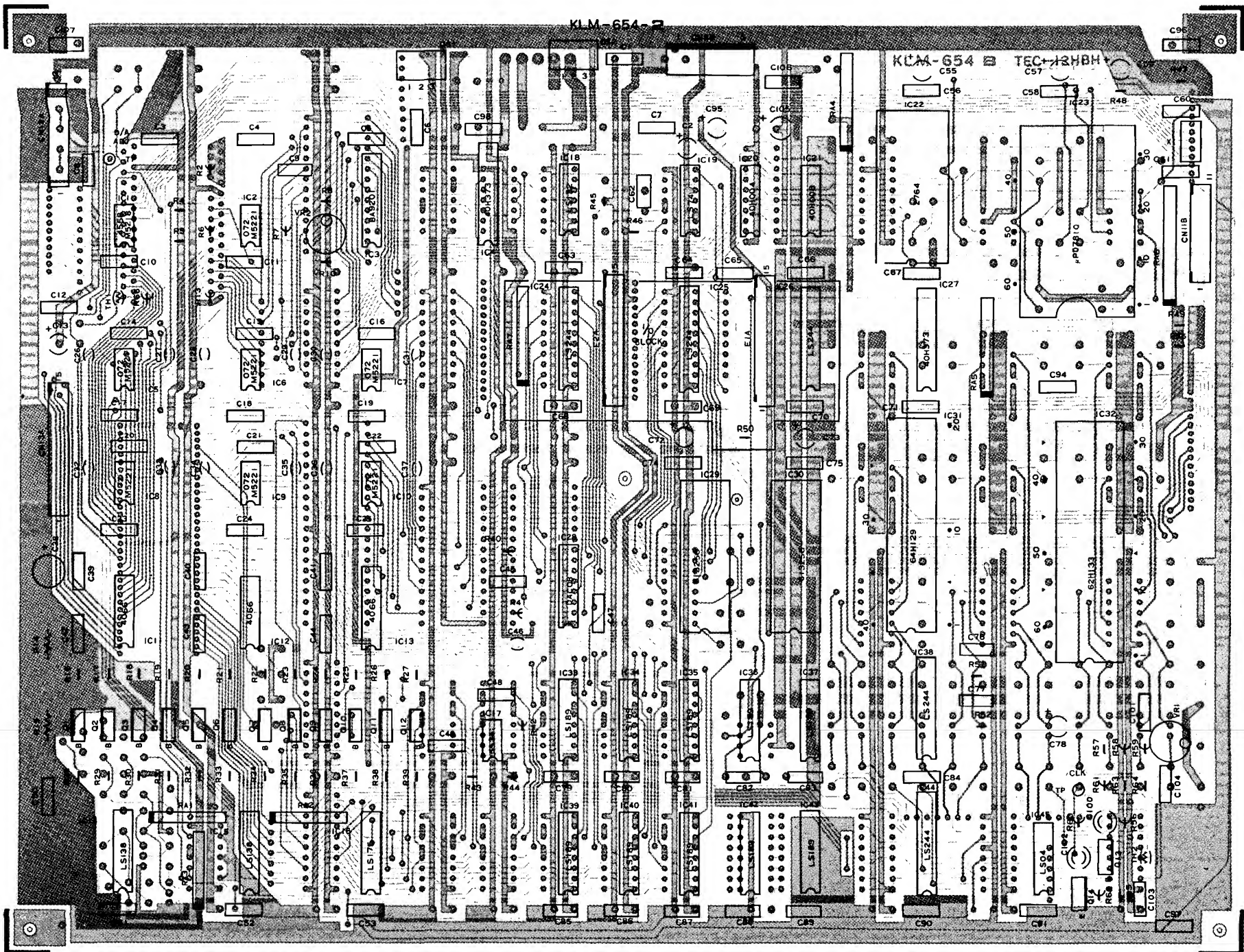
KLM-659, 660

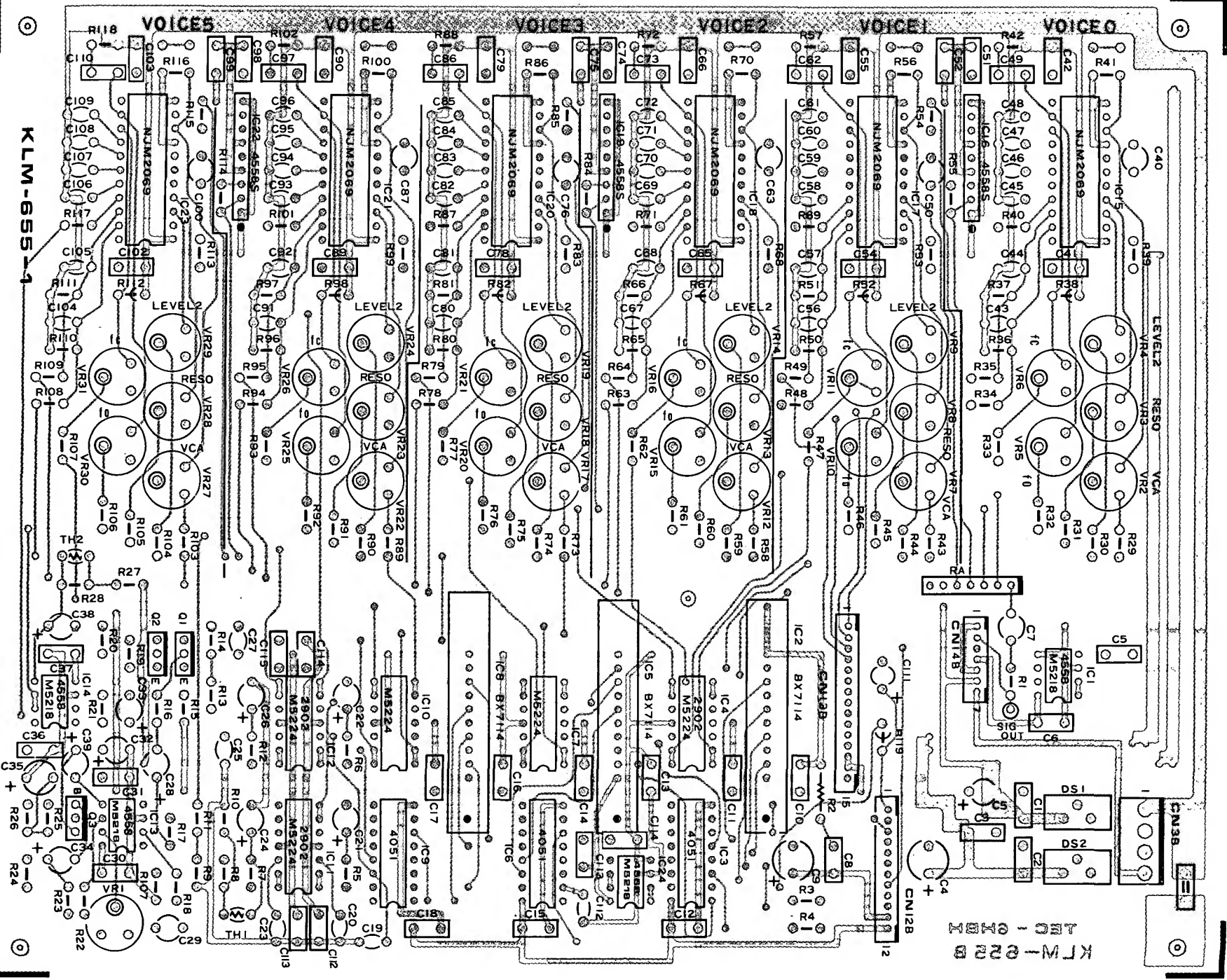


**KLM-653**





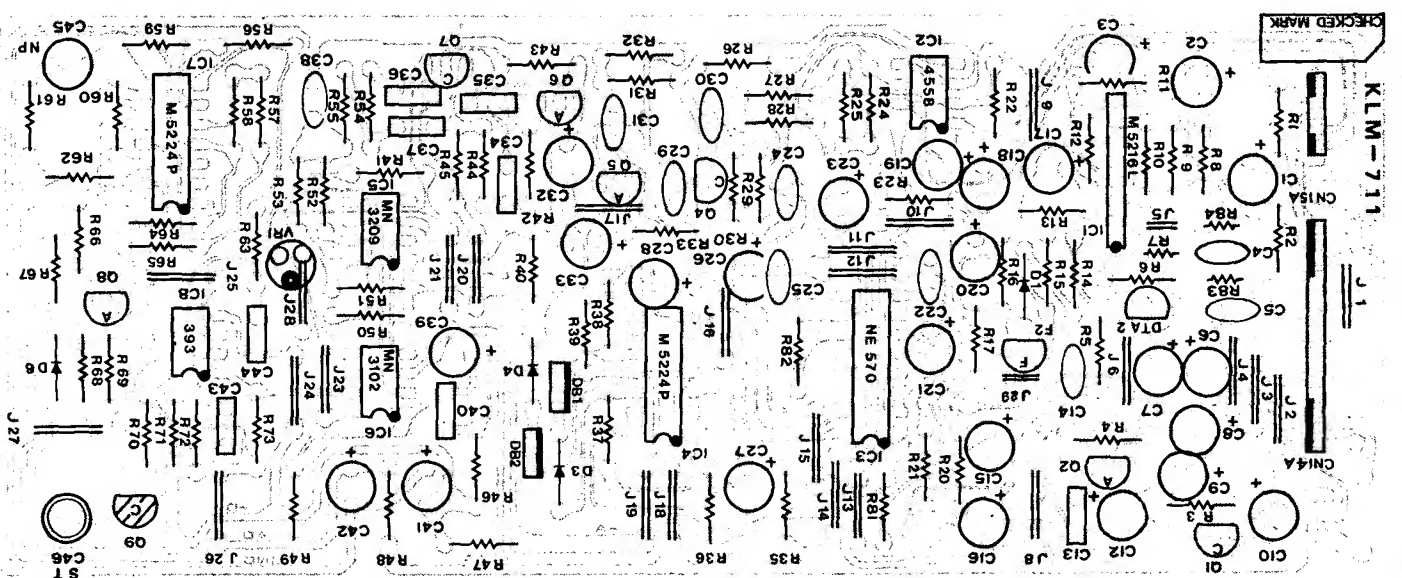
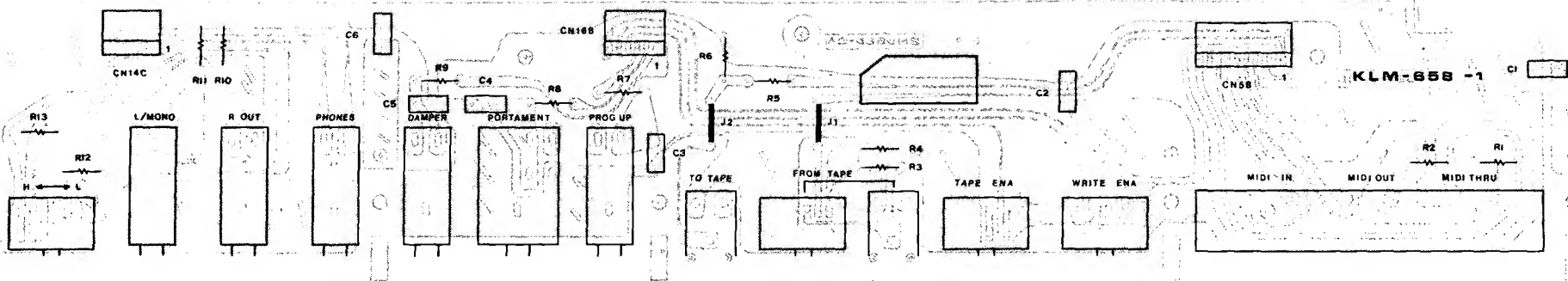




KLM-655-1

KLM-655-1  
REV. 1-6-61





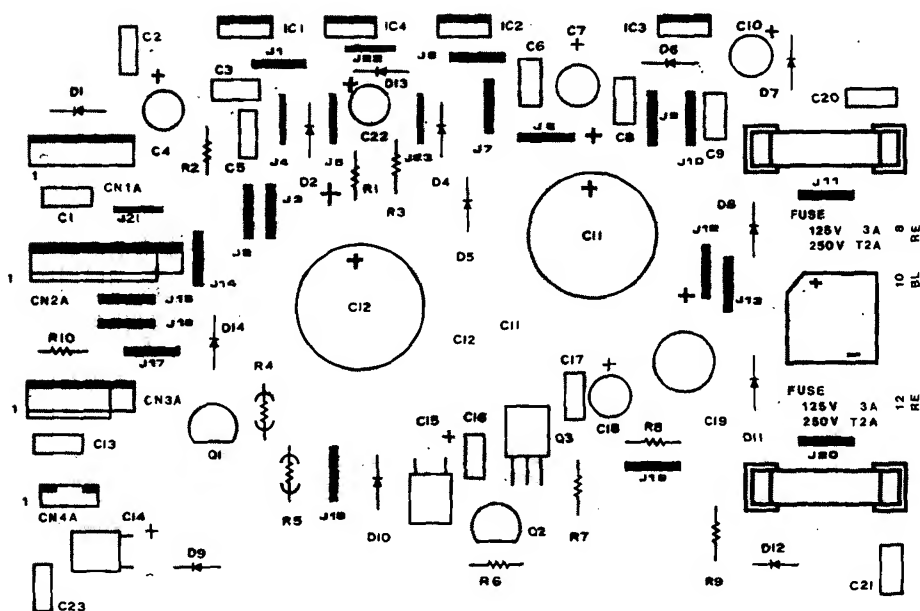


**KLM-660**

Diagram illustrating the internal components and wiring of the KLM-666-1 power supply unit:

- TOV** (Terminal Over Voltage)
- TH** (Terminal Heat)
- FUSE 250V 630mA**
- FUSE 250V 800mA**
- FUSE 250V T200mA**
- C1** (Terminal 1)
- L1** (Terminal 2)
- C2** (Terminal 3)
- C3** (Terminal 4)
- SW** (Switch)
- AC-H** (AC Output)
- AC-C** (AC Output)
- J1** (Terminal 1)
- J2** (Terminal 2)
- KLM-666-1** (Unit Label)
- CAUTION** (Warning Label)

**ATTENTION** UTILISER UN FUSIBLE  
DE RECHANGE DE MEME TYPE.



**KLM-860-1**

**ATTENTION** UTILISER UN FUSIBLE DE  
RECHANGE DE MEME TYPE.

## 8. CIRCUIT DESCRIPTIONS

### 1. Circuit boards

As shown in the block diagram, the DW-6000 uses the following circuit boards:

KLM-653: Manages function center of DW-6000 including Scanner, assigner, programmer, tape interface, and MIDI interface.

KLM-654: Main board of DWGS system.

KLM-655: Consists of 6-voice mixer, VCF, VCA, and noise circuit.

KLM-656: Control knob and assign mode switching.

KLM-657: LED segment display and switch matrix.

KLM-658: Jacks.

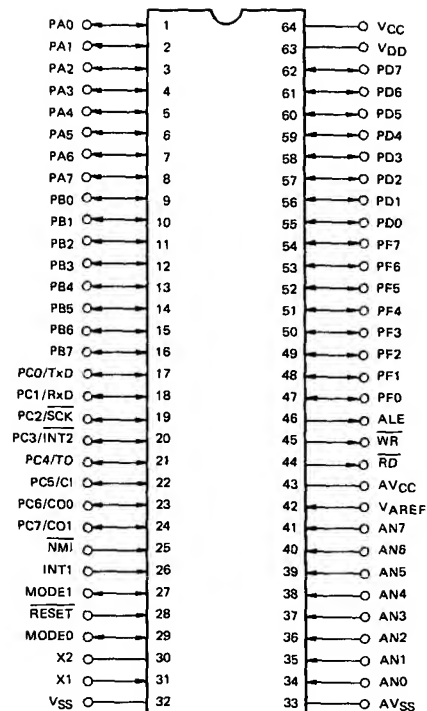
KLM-659, 660: Power supply.

KLM-711: Chorus, headphone amp. etc.

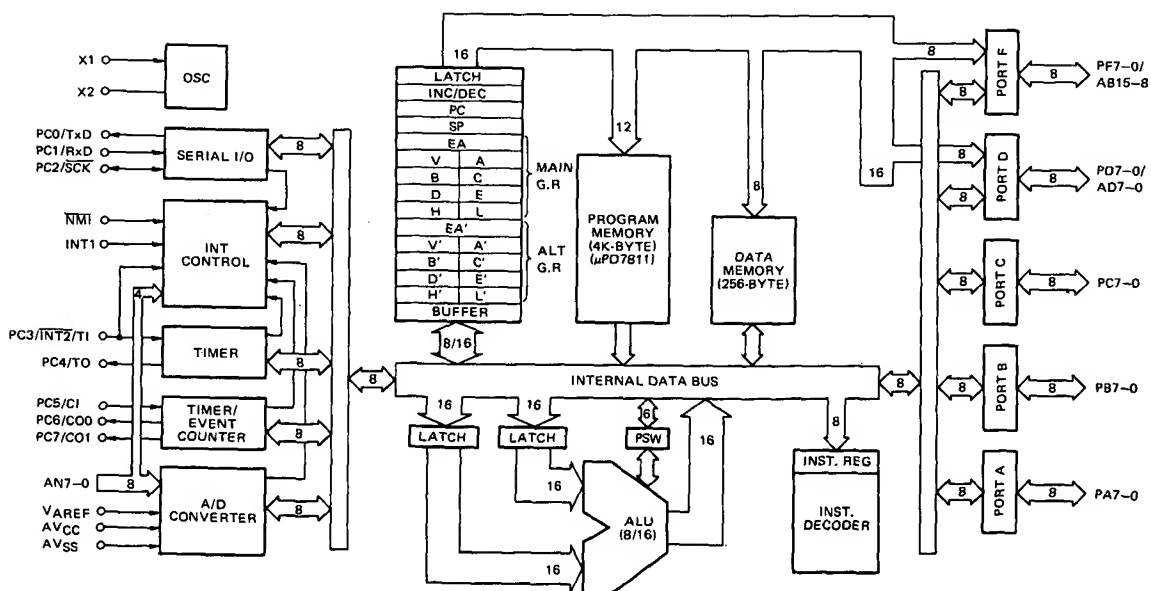
### 2. Circuit descriptions

#### (1) KLM-653:

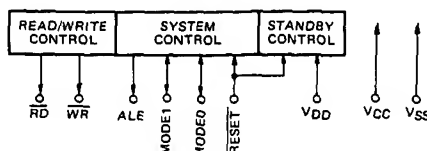
The CPU is an A/D converter equipped one-chip 8-bit microcomputer; the ports can be given various functions depending on the software.



PA7 - 0	: Port A	MODE0, 1	: Mode 0, 1
PB7 - 0	: Port B	X1, X2	: Crystal
PC7 - 0	: Port C	AN7 - 0	: Analog Input
PD7 - 0	: Port D	RD	: Read Strobe
PE7 - 0	: Port E	WR	: Write Strobe
NMI	: Non Maskable Interrupt	ALE	: Address Latch Enable
INT1	: Interrupt Request	RESET	: Reset
		VAREF	: Reference Voltage



Note:  $\mu$ PD7810 does not contain a program memory (4K-byte).



DW-6000 port functions are as follows:

**Port A (PA0~PA7):** The keyboard matrix and switch matrix input port. IC9 and IC10 (4050) are non-inverting buffers.

**Port B (PB0~PB3):** A 4-bit output port for switch matrix row control signals. Decoding is performed by IC11 (LS138) and IC12 (LS139), which have 12 outputs.

**TXD, RXD:** Serial I/O data terminals for MIDI OUT and MIDI IN, respectively. MIDI IN/OUT and MIDI THRU circuits consist of the photo-coupler PC1 (TLP552) and IC14 (LS09) AND circuit.

**Port C:** The two bits handled by PC5 and PC6 are for the tape interface output terminal (TO TAPE), with Q1 (C2785) and C7 (0.047μ) used for conversion to audio level.

PC7 is for the tape interface input terminal (FROM TAPE), with IC16 (4558), DB4 (MC931), and DB5 (MC921) used for wave shaping from audio level to square wave.

**AN0~AN3:** A/D converter input terminal for input of joystick x, y, tune control, and slider variable resistors. 1/2 IC17 (4558) determines joystick center value.

**AD0~AD7:** This terminal is for the lower 8-bit address bus and data bus. The lower address bus is latched by IC6 (LS373).

**AB8~AB15:** Upper address output port. Performs ROM and RAM addressing with AB8 ~ AB12 and chip selection with AB13 ~ AB15.

IC2 (2764) is an EPROM chip containing the data and system program for operating the CPU (IC1 (μPD7811)).

IC3 (HM-6116) is RAM for storage of user created sound data, protected by the CR2032-F1 backup battery.

IC7 (H374) works as an interface between CPU1 and CPU2.

IC18 (S-8054HN) is a 3-terminal IC for system resetting: IC17 (4558) and Q2, Q3 (A1175) are used for MIDI power supply; at the same time this is input to the CPU AN4 terminal for leading edge detection.

## (2) KLM-654:

This board contains the DWGS basic system. The purpose of this system is to get pitch and waveform data from the CPU bus and output a cyclic (repetitive) waveform of constant amplitude.

## Oscillator operation

The PAI (phase angle increment) value and PAR (phase angle register) value are added and the result is stored again in the PAR. The PAR value is used as the wave table address. The wave table stores different harmonic configuration data for each octave on the keyboard.

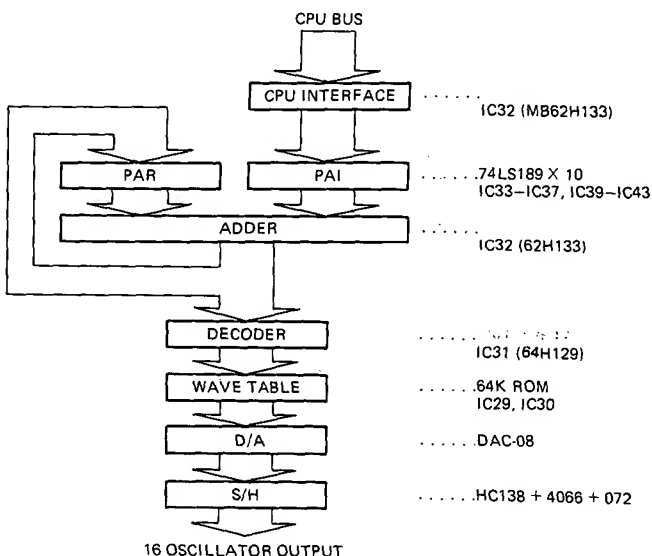
IC29 (MB64H129) performs the processing needed to use the PAR value as the wave table address.

Finally, data read from the wave table is converted to an analog waveform by a D/A converter.

Time division multiplexing enables dual oscillator 6-voice sound source capability.

(Maximum simultaneous output of this system is 8 voices x 2 oscillators.)

**Note:** Given a sampling frequency of 50 kHz, PAI data  $N = 2^{18} \times f / 50 \times 10^3$  (where f is the pitch frequency) is rounded to an integer value for N and converted to a hexadecimal number.



The main LSI chips are the CMOS gate array IC31 (MB-64H129) and IC32 (MB62H133), the wave-table 256K mask ROM IC29 and IC30 (HN613256), the ten TTL 64-bit RAM chips for PAI & PAR (IC33~IC37, IC39~IC43; S189), the 8-bit D/A converter IC28 (DAC-08), decoder chips IC38, IC44 (LS244), IC16 (LS175), IC14, IC15 (LS138), as well as S/H analog switches (IC11~IC13; 4066) and OP AMPS (IC5~IC10; 072).

IC32 (MB62H133) is a 64-pin LSI with about 800 gates handling major aspects of the system including the CPU interface, timing generation, and adder.

### MB62H133 TERMINAL NAMES

Pin No.	Type	Term	Pin No.	Type	Term	Pin No.	Type	Term
1	Input	A0	23	Input	CS	44	Bus	DB18
2	Input	A1	24	Input	WR	45	Bus	DB17
3	Input	A2	25	Input	RST	46	Bus	DB16
4	Input	A3	26	Input	CLK	47	Bus	DB15
5	Input	A4	27	Output	SHEN	48	Power supply	VSS
6	Input	D0	28	Output	VN3	49	Bus	DB14
7	Input	D1	29	Output	VN2	50	Bus	DB13
8	Input	D2	30	Output	VN1	51	Bus	DB12
9	Input	D3	31	Output	VN0	52	Bus	DB11
10	Input	D4	32	Power supply	VDD	53	Bus	DB10
11	Input	D5	33	Output	RAMC	54	Bus	DB9
12	Input	D6	34	Output	WFW	55	Bus	DB8
13	Input	D7	35	Output	PAIW	56	Bus	DB7
14	Input	D8	36	Output	PAIS	57	Bus	DB6
15	Input	D9	37	Output	PARW	58	Bus	DB5
16	Power supply	VSS	38	Output	PARS	59	Bus	DB4
17	Input	D10	39	Output	WFG	60	Bus	DB3
18	Input	D11	40	Output	OCT2	61	Bus	DB2
19	Input	D12	41	Output	OCT1	62	Bus	DB1
20	Input	D13	42	Output	OCT0	63	Bus	DB0
21	Input	D14	43	Bus	DB19	64	Power supply	VDD
22	Input	D15						

IC31 (MB64H129) is used mainly for wave table ROM address decoding; it is a 40-pin LSI having about 400 gates.

### MB64H129 TERMINAL NAMES

Pin No.	Type	Term	Pin No.	Type	Term	Pin No.	Type	Term
1	Input	DB0	15	Input	OCT0	28	Output	AO9
2	Input	DB1	16	Input	OCT1	29	Output	AO8
3	Input	DB2	17	Input	OCT2	30	Power supply	VDD
4	Input	DB3	18	Input	WFG	31	N.C.	
5	Input	DB4	19	Input	FNG	32	Output	AO7
6	Input	DB5	20	Input	RST	33	Output	AO6
7	Input	DB6	21	N.C.		34	Output	AO5
8	Input	DB7	22	Output	CEC	35	Output	AO4
9	Input	DB8	23	Output	CEB	36	Output	AO3
10	Power supply	VSS	24	Output	CEA	37	Output	AO2
11	N.C.		25	Output	AO12	38	Output	AO1
12	Input	DB9	26	Output	AO11	39	Output	AO0
13	Input	DB10	27	Output	AO10	40	N.C.	
14	Input	DB11						

IC29 and IC30 (HN613256) store digitally encoded harmonic waveforms of the harmonics 2, 5, 10, 20, 40, 80, 160, and 320.

Here a waveform including the 320th harmonic refers to addition of the sine value 320 times at a particular phase.

### (3) KLM-655

This activates the six independent VCF and VCA modules (voice0 ~ voice5) for DWGS signal (CN13B) and control signal (CN12B) inputs.

This board has many adjustment points. Please refer to the following check and adjustment procedure section for tune up and trouble-shooting details.

## 9. CHECK AND ADJUSTMENT PROCEDURE

### Caution:

1. This product has been adjusted completely at the factory before shipment. Therefore, do not adjust any points other than those deemed necessary.
2. Wait at least 15 minutes after turning on the power before making any adjustments.

PROGRAM No. 11

OSC 1					
11 OCTAVE	12 WAVEFORM	13 LEVEL			
8	4	31			
OSC 2					
21 OCTAVE	22 WAVEFORM	23 LEVEL	24 INTERVAL	25 DETUNE	NOISE
8	4	0	1	0	0
VCF					
31 CUTOFF	32 RESONANCE	33 KBD TRACK	34 POLARITY	35 EG INT	CHORUS
63	0	0	1	0	0
VCF EG					
41 ATTACK	42 DECAY	43 BREAK P.	44 SLOPE	45 SUSTAIN	46 RELEASE
VCA EG					
51 ATTACK	52 DECAY	53 BREAK P.	54 SLOPE	55 SUSTAIN	56 RELEASE
0	0	31	0	31	0
MG 1					
61 FREQ	62 DELAY	63 PITCH	64 VCF		
		0			
BEND					
71 PITCH	72 VCF	PORTAMENTO		ASSIGN MODE	
	0			POLY 1	

PROGRAM No. 14

OSC 1					
11 OCTAVE	12 WAVEFORM	13 LEVEL			
		0			
OSC 2					
21 OCTAVE	22 WAVEFORM	23 LEVEL	24 INTERVAL	25 DETUNE	NOISE
		0			0
VCF					
31 CUTOFF	32 RESONANCE	33 KBD TRACK	34 POLARITY	35 EG INT	CHORUS
44	31	0	1	0	0
VCF EG					
41 ATTACK	42 DECAY	43 BREAK P.	44 SLOPE	45 SUSTAIN	46 RELEASE
VCA EG					
51 ATTACK	52 DECAY	53 BREAK P.	54 SLOPE	55 SUSTAIN	56 RELEASE
0	0	31	0	31	0
MG 1					
61 FREQ	62 DELAY	63 PITCH	64 VCF		
		0	0		
BEND					
71 PITCH	72 VCF	PORTAMENTO		ASSIGN MODE	
	0			POLY 1	

PROGRAM No. 12

OSC 1					
11 OCTAVE	12 WAVEFORM	13 LEVEL			
8	4	0			
OSC 2					
21 OCTAVE	22 WAVEFORM	23 LEVEL	24 INTERVAL	25 DETUNE	NOISE
8	4	31	1	0	0
VCF					
31 CUTOFF	32 RESONANCE	33 KBD TRACK	34 POLARITY	35 EG INT	CHORUS
63	0	0	1	0	0
VCF EG					
41 ATTACK	42 DECAY	43 BREAK P.	44 SLOPE	45 SUSTAIN	46 RELEASE
VCA EG					
51 ATTACK	52 DECAY	53 BREAK P.	54 SLOPE	55 SUSTAIN	56 RELEASE
0	0	31	0	31	0
MG 1					
61 FREQ	62 DELAY	63 PITCH	64 VCF		
		0	0		
BEND					
71 PITCH	72 VCF	PORTAMENTO		ASSIGN MODE	
	0			POLY 1	

PROGRAM No. 15

OSC 1					
11 OCTAVE	12 WAVEFORM	13 LEVEL			
		0			
OSC 2					
21 OCTAVE	22 WAVEFORM	23 LEVEL	24 INTERVAL	25 DETUNE	NOISE
		0			31
VCF					
31 CUTOFF	32 RESONANCE	33 KBD TRACK	34 POLARITY	35 EG INT	CHORUS
63	0	0	1	0	0
VCF EG					
41 ATTACK	42 DECAY	43 BREAK P.	44 SLOPE	45 SUSTAIN	46 RELEASE
VCA EG					
51 ATTACK	52 DECAY	53 BREAK P.	54 SLOPE	55 SUSTAIN	56 RELEASE
0	0	31	0	31	0
MG 1					
61 FREQ	62 DELAY	63 PITCH	64 VCF		
		0	0		
BEND					
71 PITCH	72 VCF	PORTAMENTO		ASSIGN MODE	
	0			POLY 1	

PROGRAM No. 13

OSC 1					
11 OCTAVE	12 WAVEFORM	13 LEVEL			
		0			
OSC 2					
21 OCTAVE	22 WAVEFORM	23 LEVEL	24 INTERVAL	25 DETUNE	NOISE
		0			0
VCF					
31 CUTOFF	32 RESONANCE	33 KBD TRACK	34 POLARITY	35 EG INT	CHORUS
32	31	0	1	0	0
VCF EG					
41 ATTACK	42 DECAY	43 BREAK P.	44 SLOPE	45 SUSTAIN	46 RELEASE
VCA EG					
51 ATTACK	52 DECAY	53 BREAK P.	54 SLOPE	55 SUSTAIN	56 RELEASE
0	0	31	0	31	0
MG 1					
61 FREQ	62 DELAY	63 PITCH	64 VCF		
		0	0		
BEND					
71 PITCH	72 VCF	PORTAMENTO		ASSIGN MODE	
	0			POLY 1	

Use the settings listed below for the check and adjustment procedures. For convenience, save these settings on tape

so that they can be loaded quickly the next time DW-6000 servicing is required.

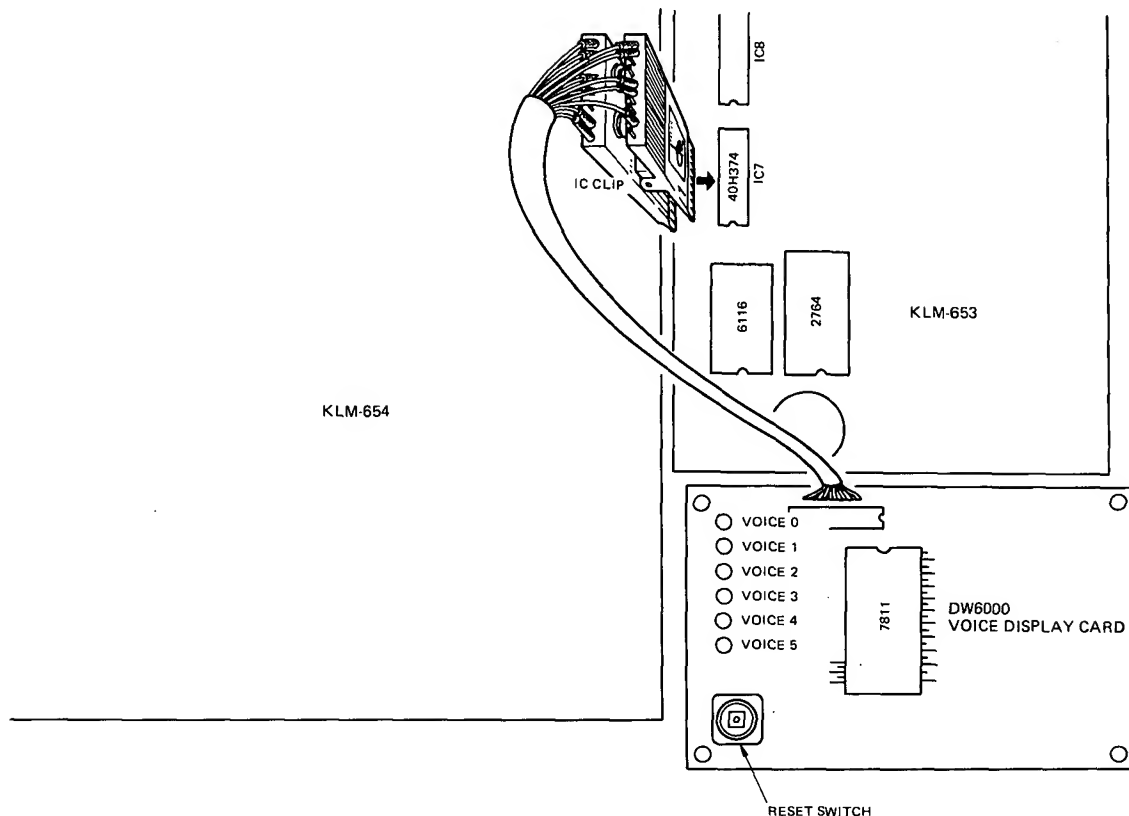


Fig-1

You should have received the DW-6000 voice display card by separate mail. This is used to show which voice is operating when keys are played on the keyboard. (See figure 1.) Turn off the power on the DW-6000 and connect the card's IC clip to IC7 (40H374) on the KLM-653 board. Be sure that the "1" marked on the clip is at the IC7 number 1 pin side.

If the DW-6000 or the voice display card starts behaving erratically, reset the card by pressing its reset button. (And reset the DW-6000 by turning its power off and on again.)

Be sure to turn off the power on the DW-6000 before removing the voice display card.

### 1. D/A converter (DAC) reference voltage check and adjustment. (KLM-654)

1) Connect a digital voltmeter (DVM) to the KLM-654 D/A check point (or IC1 [4558] 7 pin) (connect ground to C31 GND side), confirm a reading in the range of 1.995V ~2.005V.

2) Adjust VR2 if necessary to obtain a value that meets the above specification.

### 2. DWGS Clock check and adjustment. (KLM-654)

1) Connect a frequency counter to the clock adjustment test point or IC45 (LS04) 6-pin (ground goes to C104

ground side). Confirm a DWGS clock frequency within the range of 6,395kHz~6,405kHz.

2) Adjust VR1 if necessary.

### 3. OSC1 (oscillator 1) VCA level check and adjustment (KLM-655)

1) Connect an oscilloscope to the KLM-655 test point (ground goes to C6 GND side).

2) Select program number 11.

3) Play key C3 and confirm a waveform level of 0.5V p-p ( $\pm 20\text{mV}$  p-p) (fig-2).

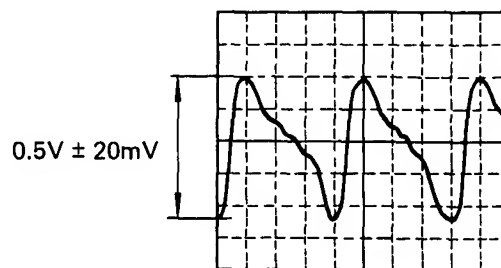


Fig-2

4) Check all six voices in the same way.

5) If a voice does not meet the level specification, adjust it by turning its VCA adjustment VR: No. 2, 7, 12, 17, 22, or 27.

#### 4. OSC2 (oscillator 2) VCA level check and adjustment.

- 1) Connect an oscilloscope to the KLM-655 test point (ground goes to C6 GND side).
- 2) Select program number 12.
- 3) Play key C3 and confirm a waveform level of 0.5V p-p ( $\pm 20\text{mV}$  p-p) (Same as fig-2).
- 4) Check all six voices in the same way.
- 5) If a voice does not meet the level specification, adjust it by turning its LEVEL 2 VCA adjustment VR: No. 4, 9, 14, 19, 24, or 29.

#### 5. Resonance level check and adjustment.

(A)

- 1) Connect an oscilloscope to the KLM-655 test point (ground goes to C6 GND side).
- 2) Select program number 13.
- 3) Play any key and confirm a waveform level of 0.5V p-p ( $\pm 40\text{mV}$  p-p) (fig-3).

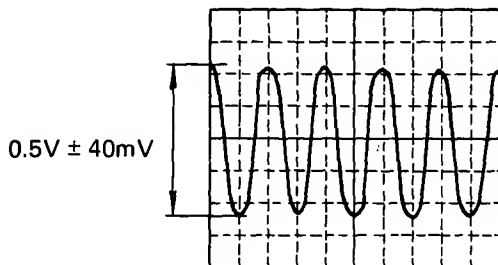


Fig-3

- 4) Check all six voices in the same way.
- 5) If a voice does not meet the level specification, adjust it by turning its resonance adjustment (RESO ADJ) VR: No. 3, 8, 13, 18, 23, or 28.

(B) fo check and adjustment.

- 1) Connect an oscilloscope to the KLM-655 test point (ground goes to C6 GND side).
- 2) Select program number 13.
- 3) Connect a tuner to the output jack.
- 4) Play any single key and confirm a tuner reading of 0 cent ( $\pm 10$  cents) deviation for that pitch at "C".
- 5) Check all six voices in the same way. If a voice does not meet specification, adjust its fo adjustment VR: No. 5, 10, 15, 20, 25, or 30.

#### 6. fc slope check and adjustment.

- 1) Connect an oscilloscope to the KLM-655 test point (ground goes to C6 GND side).
- 2) Select program number 14.
- 3) Connect a tuner to the output jack.
- 4) Play any single key and confirm a tuner reading of 0 cent ( $\pm 10$  cents) deviation for that pitch at "C".
- 5) Check all six voices in the same way. If a voice does not meet specification, adjust its fc adjustment VR: No. 6, 11, 16, 21, 26, or 31.

#### 7. Noise level check and adjustment.

- 1) Connect an oscilloscope to the KLM-655 test point (ground goes to C6 GND side).
- 2) Select program number 16.
- 3) Play any single key and confirm that 80% of the waveform level is  $0.2\text{V} \sim 0.4\text{V}$  p-p. (fig-4)

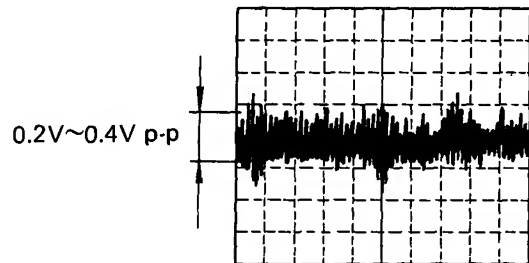


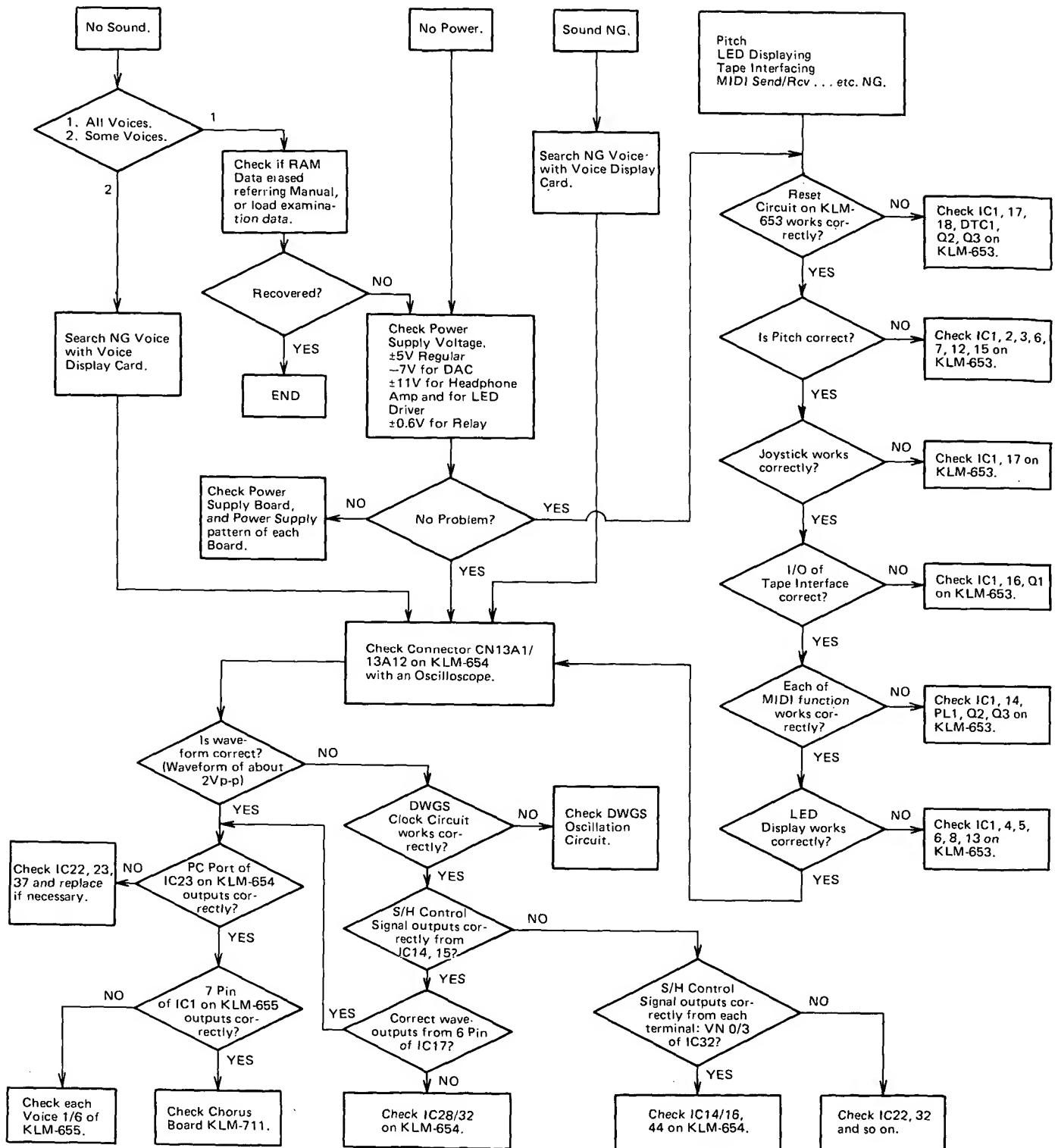
Fig-4

- 4) Adjust VR1 if necessary.

#### 8. BBD input distortion check and adjustment.

- 1) Connect a signal generator to KLM-711 connector CN-14B-1 and input a 1 kHz sine wave at a level of 6V p-p.
- 2) Connect an oscilloscope to the KLM-711 IC5 3-pin and confirm that there is no distortion in the observed waveform.
- 3) If there is distortion in the observable waveform, eliminate it by adjusting VR1.

# 10. TROUBLESHOOTING TABLE



**Note:** Please check if each ICs, LSIs on each board is heated irregularly.  
RAM (LS189), however, has rather higher heat than other LSIs regularly.



# 11. PARTS LIST

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
CARBON RESISTORS				
10016000	1/6JY 0Ω	KLM-658		1
10113747	S1/4JT 4.7M	KLM-653		1
10413147	S1/4JYTP 4.7Ω	KLM-660		1
10413210	S1/4JYTP 10Ω	KLM-711		4
10413215	S1/4JYTP 15Ω			2
10413247	S1/4JYTP 47Ω	KLM-656		1
10413310	S1/4JYTP 100Ω			2
		KLM-711		2
10413327	S1/4JYTP 270Ω	KLM-660		1
10413333	S1/4JYTP 330Ω	KLM-657		8
10413347	S1/4JYTP 470Ω	KLM-656		1
		KLM-660		1
10413410	S1/4JYTP 1K			4
		KLM-711		4
10413422	S1/4JYTP 2.2K			2
10413433	S1/4JYTP 3.3K	KLM-657		3
10413447	S1/4JYTP 4.7K	KLM-711		5
10413510	S1/4JYTP 10K	KLM-657		9
		KLM-711		4
10413512	S1/4JYTP 12K			8
10413513	S1/4JYTP 13K			1
10413520	S1/4JYTP 20K			1
10413522	S1/4JYTP 22K	KLM-660		1
		KLM-711		3
10413524	S1/4JYTP 24K			2
10413527	S1/4JYTP 27K			2
10413533	S1/4JYTP 33K			2
10413536	S1/4JYTP 36K			1
10413539	S1/4JYTP 39K			3
10413547	S1/4JYTP 47K	KLM-656		1
		KLM-711		5
10413575	S1/4JYTP 75K	KLM-711		2
10413610	S1/4JYTP 100K			11
10413612	S1/4JYTP 120K			1
10413615	S1/4JYTP 150K			2
10413622	S1/4JYTP 220K	KLM-656		1
		KLM-711		1
10413682	S1/4JYTP 820K			1
10413710	S1/4JYTP 1M			1
10413810	S1/4JYTP 10M			1
10416000	1/6JTP 0Ω	KLM-653		3
		KLM-654		3
		KLM-655		3
		KLM-711		2
10416210	1/6JTP 10Ω	KLM-654		1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
10416247	1/6JTP 47Ω	KLM-653		1
		KLM-654		1
		KLM-655		8
10416262	1/6JTP 62Ω	KLM-654		1
10416310	1/6JTP 100Ω			1
		KLM-655		1
10416315	1/6JTP 150Ω	KLM-654		2
10416322	1/6JTP 220Ω	KLM-653		4
		KLM-654		1
		KLM-655		13
10416362	1/6JTP 620Ω	KLM-653		1
10416375	1/6JTP 750Ω			1
10416410	1/6JTP 1.0K	KLM-654		12
10416418	1/6JTP 1.8K	KLM-655		1
10416420	1/6JTP 2.0K			4
10416422	1/6JTP 2.2K	KLM-653		1
10416433	1/6JTP 3.3K			1
10416447	1/6JTP 4.7K			5
		KLM-654		13
10416447	1/6JTP 4.7K	KLM-655		1
10416451	1/6JTP 5.1K	KLM-653		1
10416456	1/6JTP 5.6K			1
		KLM-655		7
10416462	1/6JTP 6.2K			1
10416468	1/6JTP 6.8K	KLM-653		1
		KLM-655		13
10416482	1/6JTP 8.2K	KLM-653		1
10416510	1/6JTP 10K			8
		KLM-654		3
		KLM-655		13
10416511	1/6JTP 11K		Δ; 10416745 7.5K	6
10416516	1/6JTP 16K			6
10416522	1/6JTP 22K	KLM-653		3
		KLM-654		1
		KLM-655		1
10416527	1/6JTP 27K			6
10416530	1/6JTP 30K	KLM-654		2
		KLM-655		12
10416533	1/6JTP 33K	KLM-653		1
		KLM-655		1
10416547	1/6JTP 47K	KLM-653		1
		KLM-655		13
10416568	1/6JTP 68K	KLM-653		1
10416610	1/6JTP 100K			1
		KLM-654		1
		KLM-655		2

NOTE Δ; MODIFICATION

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
10416615	1/6JTP 150K	KLM-653 KLM-655 KLM-711		1 2 1
10416620	1/6JTP 200K	KLM-653		1
10416710	1/6JTP 1.0M	KLM-655		1
10509000	YLC 0Ω	KLM-658 KLM-659		2 2
10513147	S1/4JYLC 4.7Ω	KLM-654 KLM-655		2 1
10513215	S1/4JYLC 15Ω	KLM-658		1
10513322	S1/6JYLC 220Ω			2
10513410	S1/4JYLC 1K			3
10513439	S1/4JYLC 3.9K			1
10513482	S1/4JYLC 8.2K			1
10513510	S1/4JYLC 10K			2
10513515	S1/4JYLC 15K			1
10513610	S1/4JYLC 100K			2
METAL FILM RESISTORS				
12413232	1/4TP 232Ω	KLM-660		1
12414100	1/4TP 1.00K			1
12513402	1/6TP 402Ω	KLM-654		2
12514100	1/6TP 1.00K			2
		KLM-655		6
12514140	1/6TP 1.4K	KLM-654 KLM-655 KLM-654		2 1 1
12514147	1/6TP 1.47K			1
12514169	1/6TP 1.69K			1
12514200	1/6TP 2.0K			5
12514309	1/6TP 3.09K			2
12514422	1/6TP 4.22K			2
12515102	1/6TP 10.2K	KLM-653		2
BLOCK RESISTORS				
13504547	RKC1/8 B4J 47K			1
13505522	RKC1/8 B5J 22K	KLM-654		1
13506410	RKC1/8 B6J 1K			2
13506522	RKC1/8 B6J 22K	KLM-655		1
13508522	RKC1/8 B8J 22K	KLM-653 KLM-654		3 2
13510522	RKC1/8B10J 22K	KLM-653 KLM-654		1 1
THERMISTORS				
18032310	TD5-A110DA	KLM-654		1
18032410	TD5-C210DA	KLM-655		1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
18032450	TD5-C250DA	KLM-654 KLM-655		1 1
MYLAR CAPACITORS				
20402410	50V 0.001μF	KLM-653 KLM-655		2 24
20402412	50V 0.0012μF	KLM-711		4
20402415	50V 0.0015μF	KLM-654		12
20402422	50V 0.0022μF	KLM-711		1
20402510	50V 0.01μF	KLM-653 KLM-654 KLM-711		1 1 3
20402533	50V 0.033μF	KLM-655		12
20402547	50V 0.047μF	KLM-653 KLM-655		2 6
20402610	50V 0.1μF	KLM-711		2
STYROL CAPACITORS				
20503247	50V JT 47PF	KLM-654		2
20503410	50V JT 1000PF	KLM-711		1
CERAMIC CAPACITORS				
21353471	50V 470PF	KLM-658		3
21355470	50V 0.047UF			3
21406100	25V 0.1μF TP	KLM-653 KLM-654 KLM-655 KLM-656 KLM-657 KLM-660 KLM-711 KLM-654		22 64 49 1 1 9 4 1
21451500	50V 5PF TP			1
21452220	50V 22PF TP			1
21452330	50V 33PF TP	KLM-653 KLM-654		2 2
21453150	50V 150PF TP			2
21453470	50V 470PF TP			1
21453680	50V 680PF TP	KLM-711		4
21455100	50V 0.01μF	KLM-660		2
21455470	50V 0.047μF	KLM-653 KLM-654 KLM-656 KLM-657		1 3 1 1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
SPARK KILLER				
21900600	ECQ-U2A473MN	KLM-659		2
EMI				
21950100	DSS310-55D223S	KLM-654		1
ELECTROLYTIC CAPACITORS				
23411447	25V 4700 $\mu$ F	KLM-660		1
23411468	25V 6800 $\mu$ F			1
23511410	25V 1000 $\mu$ F			1
25401310	6.3V 100 $\mu$ F	KLM-711		1
25403210	16V 10 $\mu$ F	KLM-653		5
		KLM-654		6
		KLM-655		6
		KLM-656		1
		KLM-657		1
		KLM-711		4
25403222	16V 22 $\mu$ F	KLM-656		1
		KLM-660		1
25403247	16V 47 $\mu$ F	KLM-656		1
		KLM-660		1
		KLM-711		2
25403310	16V 100 $\mu$ F	KLM-654		1
		KLM-655		2
		KLM-660		3
		KLM-711		6
25404147	25V 4.7 $\mu$ F	KLM-660		1
25404247	25V 47 $\mu$ F			1
25406047	50V 0.47 $\mu$ F	KLM-657		3
		KLM-711		3
25406110	50V 1 $\mu$ F	KLM-653		6
		KLM-654		4
		KLM-655		6
		KLM-711		4
25406122	50V 2.2 $\mu$ F	KLM-655		1
		KLM-711		2
25406133	50V 3.3 $\mu$ F			2
25463210	16V 10 $\mu$ F	KLM-655		8
25466110	50V 1 $\mu$ F RBP.T2 2	KLM-711		1
TRANSISTORS				
30100328	TR 2SB744 A P/Q	KLM-660		1
30202235	TR 2SC2785 K2	KLM-655		2

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
30202299	TR 2SC2785 K SELECTED (Silver)			1
30400020	TR 2SA1175 K TN	KLM-653 KLM-654 KLM-657 KLM-660 KLM-711		3 12 3 2 4
30420020	TR 2SC2785 K TN	KLM-653 KLM-656 KLM-711		2 3 3
30420090	TR 2SC2901 T ALL	KLM-654 KLM-711		2 1
DIGITAL TR				
30430010	DTA-114N			1
30430020	DTC-114N	KLM-653		1
30460020	FET 2SK381-34-B	KLM-711		1
DIODES				
31001500	SR1K-2	KLM-660		11
31400100	1S1555 TP-3	KLM-656 KLM-657 KLM-660 KLM-711		2 22 2 4
31401300	1SS-133 T-77	KLM-653		4
BRIDGE DIODE				
31010200	4B4B41			1
LED				
31201900	GL 9PR24	KLM-656 KLM-657		3 2
31204500	LED LN524RA-(L)BR			2
31204600	LED LN524GA-(L)BR			1
DOUBLE DIODES				
31430100	MC-931	KLM-657 KLM-711		1 3 2
31430200	MC-921	KLM-653		1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
<b>ICs</b>				
32001065	μPD7811-161-36	KLM-653	CPU	1
		KLM-654	CPU	1
32002021	MN-3209	KLM-711	BBD	1
32002022	MN-3102	KLM-711	BBD Driver	1
32002128	MN74HC139	KLM-653	Dual 2-line to 4-line decoder	1
32002166	MN74HC373		Octal D-type transparent latch	1
		KLM-654		2
32002167	MN74HC374	KLM-653	Octal positive edge-triggered D-type flip flop	2
32003013	TC-40H004 P	KLM-654	Hex Buffer	1
32003014	TC-40H008 P		Quad 2-input and gate	1
32003059	TC-40H374 P	KLM-653	Octal D-type flip flop	1
32003117	TC74HC32P		Quad 2-input or gate	1
32004004	HD-14066 BP	KLM-654	Quad analog switch	3
		KLM-657		1
32004016	HD-14050 BP	KLM-653	Hex noninverting buffer	2
32004017	HD-14051 BP	KLM-655	8-channel analog multiplexer	3
32004028	HM-6116LP-4	KLM-653	Ram	1
32004031	HD-74LSO4 P	KLM-654	Hex inverter	1
32004066	HN-482764	KLM-653	EP ROM	1
		KLM-654		1
32004074	HD74LS09P	KLM-653	Quadruple 2-input positive and gate with open collector output	1
32004075	HN613256PM93	KLM-654	256 KBit mask ROM	1
32004076	HN613256PM94			1
32004077	HD74LS132P		Quadruple 2-input positive nand schmitt trigger	1
32007014	BA9201			1
32007015	BX7114	KLM-655		3
32009001	NJM-4558D-V	KLM-653	OP AMP	2
		KLM-654	OP AMP	1
		KLM-655	OP AMP	4
		KLM-711	OP AMP	1
32009005	NJM-4558 S	KLM-655	OP AMP	3
32009007	NJM-2902 N		OP AMP	3
32009009	NJM-012D	KLM-654	OP AMP	7
32009011	NJM-7805 A	KLM-660	Power regulator +5V	3
32009015	NJM-2903 D	KLM-711		1
32009021	NJM-7905A	KLM-660	Power regulator -5V	1
32009035	NJM5534-D	KLM-654	OP AMP	1
32009036	NJM2069A-D	KLM-655	VCF + VCA	6
32009037	DAC-08 EDC	KLM-654	D/A	1
32011020	M5224P	KLM-655	OP AMP	2
		KLM-711		2

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
32011025	M-54513P	KLM-653		1
32011026	M-5216 L	KLM -711	OP AMP	1
32011042	M54562P	KLM-653		1
32012008	MB62H133	KLM-654	Gate array	1
32012009	MB64H129		Gate array	1
32021047	SN74S189		TTL RAM	10
32021110	SN74HC74N		Dual D flip-flop	1
32021115	SN74HC138N	KLM-653	3 to 8 line decoder	1
		KLM-654		2
32021120	SN74HC175N		Quad D flip-flop	1
32021130	SN74HC244N		Octal bus buffer	2
32023005	S-8054HN	KLM-653	Reset	1
32025002	NE-571	KLM-711	Noise reduction	1
<b>PHOTO COUPLER</b>				
33001000	TLP-552	KLM-653		1
<b>CERAMIC OSCILLATOR</b>				
33501700	KBR-12.0MHz			1
		KLM-654		1
<b>P.C. BOARD WITH PARTS</b>				
34065300	KLM-653	KLM-653		1
34065400	KLM-654	KLM-654		1
34065500	KLM-655	KLM-655		1
34065600	KLM-656	KLM-656		1
34065700	KLM-657			1
34065800	KLM-658	KLM-658		1
34065900	KLM-659	KLM-659		1
34066000	KLM-660	KLM-660		1
34071100	KLM-711	KLM-711		1
<b>SEMI FIXED VR</b>				
35001422	H0651A 220KB			1
35201210	H1051A 1KB	KLM-654		1
35201268	H1051A 6.8KB	KLM-655		6
35201315	H1051A 15KB Δ		35201322 22K (6)	12 (6)
35201333	H1051A 33KB			12
35201347	H1051A 47KB	KLM-654		1
35201510	H1051A 1MB	KLM-655		1

NOTE Δ; MODIFICATION  
( ); Q'TY

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
ROTARY VR				
36015600	VR K16200005 10KB			2
SLIDE VR				
36504900	S3018P-937M 100KB	KLM-656		1
		KLM-657		1
36505000	S3028P-928M 10KB X 2	KLM-656		1
SLIDE SW				
37303900	R-S47836	KLM-658		4
TACT SW				
37505000	KHC-10901	KLM-656		3
		KLM-657		14
POWER SW				
37506600	WK-2A44			1
POWER TRANSFORMER				
40009200	TC-015A			1
RELAY				
40300700	G5A237P 9V	KLM-656		1
KEYBOARD				
42002800	ESK-7016			1
PHONE JACK				
45404200	YKB21-5004	KLM-658		1
45404400	YKB21-5010			5
45404500	YKB21-5029			2

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
FUSE				
46411801	250V 630MA UL		UNI	1
			JAM	1
			117 2P	1
46411901	250V 800MA UL		100V	1
46461301	250V T200MA		220 GE	1
			220 SE	1
			240 AF	1
			240 AU	1
			DEMKO	1
			SEMKO	1
			NEMKO	1
			240 GE	1
			GAF	1
			FIMKO	1
			240 RM	1
HARNESS				
47043300	HNS-333 1A-1B			1
47043400	HNS-334 2A-2B			1
47043500	HNS-335 3A-3B			1
47043600	HNS-336 4A-4B	KLM-656		1
47043700	HNS-337 5A-5B			1
47043800	HNS-338 6A-6B	KLM-656		1
47043900	HNS-339 7A-7B	KLM-657		1
47044000	HNS-340 8A-8B			1
47044100	HNS-341 9A-9B			1
47044200	HNS-342 10A-10B			1
47044300	HNS-343 11A-11B	KLM-654		1
47044400	HNS-344 12A-12V			1
47044500	HNS-345 13A-13B			1
47044600	HNS-346 14A-14B-14C			1
47044700	HNS-347 15A-15B	KLM-656		1
47044800	HNS-348 16A-16B	KLM-657		1
47044900	HNS-349 17A-17B			1
47045000	HNS-350 No. 20			1
CONNECTOR				
47150400	B4P-VH	KLM-653		1
		KLM-655		1
		KLM-660		2
47150500	B5P-VH	KLM-654		1
		KLM-660		1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
47170400	B4B-PH	KLM-653 KLM-711 KLM-655 KLM-653  KLM-655  KLM-711 KLM-658 KLM-656 KLM-657 KLM-658		1
47170500	B4B-PH			1
47170700	B7B-PH			1
47170800	B8B-PH			2
47171000	B10B-PH			1
47171100	B11B-PH			2
47171200	B12B-PH			1
47171500	B15B-PH			1
47270600	S6B-PH			2
47270800	S8B-PH			1
47271000	S10B-PH			2
				1
<b>IC SOCKET</b>				
48001282	28P DICA-28CTI	KLM-653 KLM-654		1 1
<b>DIN JACK SOCKET (X 3)</b>				
48010180	M-1704	KLM-658		1
<b>RUBBER FEET</b>				
50009500				4
<b>FUSE HOLDER</b>				
51501600	S-N5053 #01	KLM-659		2
<b>LITHIC BATTERY</b>				
52001300	CR2032-FT			1
<b>TEST PIN</b>				
54007100	LC-2-G-Yellow	KLM-654 KLM-655		2 1
<b>WIRE BAND</b>				
54007200	PLT-1M			7

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
<b>ISOLATING WASHER</b>				
54007300	B-1725K	KLM-660		4
<b>SPIRAL CLIP</b>				
54008600	CS-8			5
<b>SPACER</b>				
54010700		KLM-657		3
<b>INLET SOCKET</b>				
54010900	PA-126			1
<b>PLASTIC RIVET FOR DIN JACK</b>				
54011000				2
<b>CLUMP</b>				
54011100	CK-07H			2
<b>RADIATION SHEET</b>				
56500300	BFG-30	KLM-660		4
<b>LED HOLDER</b>				
57502500	3 x 6 x 6.5	KLM-656 KLM-657		3 2
<b>SHIELDING SHEET</b>				
58021100				1
<b>AC CORD</b>				
60002100	SPT-2 UC-695-S01		UNI 117 2P	1 1
60002200	CEE EC-215-S01		220 GE 220 SE 240 AF DEMKO SEMKO NEMKO	1 1 1 1 1 1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
60002300	SAA SC-455-S01		240 GE	1
60002400	DC-325-S01		GAF	1
60002500	BS BH-115-S01		FIMKO	1
60002600	CSA UC-707-S01		240 AU	1
			100V	1
			240 RM	1
CONNECTION CORD PLUG 6.3				
60201302				1
SLIDE VR KNOB NO. 2				
62010001				3
TACT SW KNOB LIGHT IVR				
62011300	A LIGHT IVR			11
62011301	A RED			1
62011400	B IVR			5
JOYSTICK LEVER KNOB				
62012200				1
PARAMETER SHEET				
63000600				1
LED DISPLAY COVER				
63000700				1
PRELOAD DATA SHEET				
63000800				1
SHIELDING SHEET				
63000900				1
JOYSTICK Y-SUPPORT				
64058400				1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
JOYSTICK LEVER FIX PIN				
64058402				2
UPPER CASE SUPPORT				
64066700				2
HEAT SINK				
64066800				1
RADIATOR				
64066900				1
LOWER CASE				
64067000				1
METAL FITTING OF SW				
64067100				1
DIN JACK PLATE				
64067300				2
JOYSTICK BOX				
64610100				1
JOYSTICK X-SUPPORT				
64610101				1
JOYSTICK LEVER				
64616100				1
UPPER CASE				
64619700				1

PARTS CODE	PARTS NAME SPECIFICATIONS	P.C. BOARD	IDENTIFICATION NO. FUNCTION	Q'TY
SCREWS				
70160308	FE F BZMC 3 x 8	KLM-660		2
70530306	FE B ZMC 3 x 6			20
70530408	FE B ZMC 4 x 8			4
70560308	FE B BZMC 3 x 8			4
70560508	FE B BZMC 5 x 8	2		
72530308	TP2G B ZMC 3 x 8	5		
72560308	TP2G B BZMC 3 x 8	2		
72560312	TP2G B BZMC 3 x 12	23		
74530308	PLAX B ZMC 3 x 8	4		
74560410	PLAX B BZMC 4 x 10	39		
				10



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